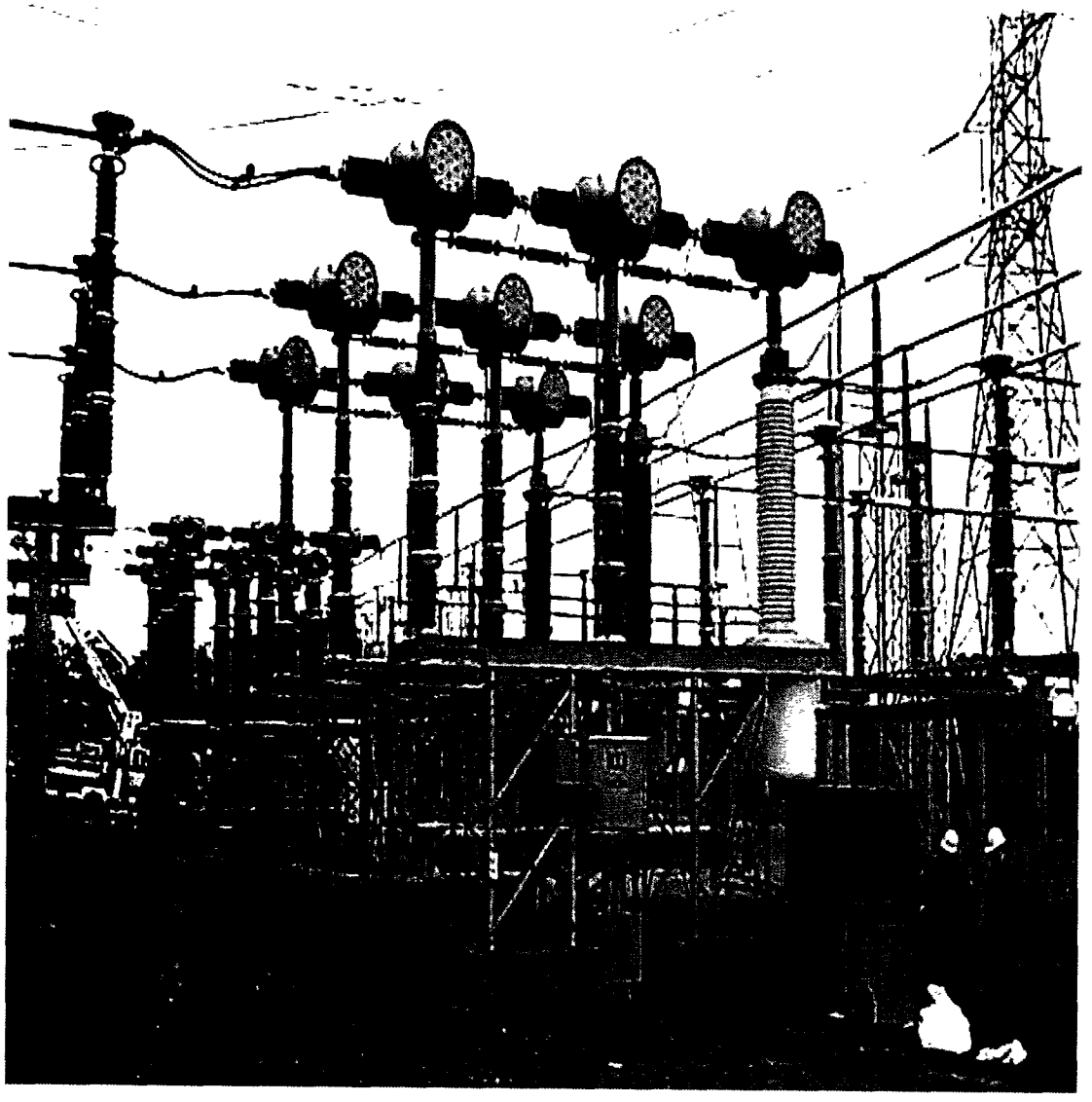


Waltham District

Bulk Substation Transformer Outages

Distribution Supply Line Outages

Thermal Results and Remedial Switching Actions

2003 T&D OPERATING STUDY
WALTHAM DISTRICT

STATION #148 NEEDHAM

Needham Station 148 serves a power supply area consisting of the Town of Needham, portions of Dover, Westwood, and Wellesley, a municipal customer. During the summer of 2002, Needham Station 148 peak load was 78 MVA.

Needham Station 148 consists of two 115/14kV transformers:

Transformer #110A: Pennsylvania 30/40/50 [56] MVA 110/13.8/13.8 kV
Transformer #110C: ABB, 37/50/62.5 MVA 117/14.4 kV

Needham Station 148 total capacity is 112.5 MVA. NSTAR employs summer emergency rating

Needham Station 148 total capacity is 112.5 MVA. NSTAR employs summer emergency rating (cyclic capability) of 68 MVA for the loss of transformer 110C. . Needham Station 148 has approximately 26 MVA of transfer switching to Station 20 in Dedham, and Station 292 in Newton. Needham Station's load carrying capability is 94 MVA.

Overload Ratings:

Transformer	Nameplate	12 hour LTE, 90F Ambient	12 hour LTE, 110F Ambient
110A	30/40/50 [56] MVA	73 MVA	68 MVA
110C	37/50/62.5 MVA	81 MVA	74 MVA

Station Capabilities:

Total Station Capacity (N)	Station Firm Capacity (LTE)	RADSEC Transfer	Manual Transfer	Total LCC
112.5 MVA	68 MVA	28 MVA	0 MVA	96 MVA

Station Load Forecast:

2004	2005	2006	2007	2008
83 MVA	84 MVA	85 MVA	86 MVA	88 MVA

Switching Actions:

Loss of Transformer #110A:

Open: Circuit Breakers #1 and #2 in Hyde Park 115kV Ring Bus
Both Main 110A 13.8kV Circuit Breakers
Disconnect Switch #T730
Close: ABR scheme closes 13.8V bus-tie breaker automatically
Circuit Breakers #1 and #2 to restore Hyde Park 115kV Ring Bus

Loss of Transformer #110C:

Open: Circuit Breakers #3 and #6 in Hyde Park 115kV Ring Bus
Main 110C 13.8kV Circuit Breaker
Circuit Switcher #CS771
Close: ABR scheme closes 13.8V bus tie-breaker automatically
Circuit Breakers #3 and #6 to restore Hyde Park 115kV Ring Bus

Transfer Switching:

For either transformer outage, the remaining in-service transformer with transfer switching supports full station load of 83.0 MVA, with 28 MVA of transfer available to other stations.

[For loss of either transformer, transfer of the following DSS lines via RADSEC switches may also be required]:

Needham 148-H6 to Newton Highlands 292-H10 via close RADSEC MRU 827 and open RADSEC MRU 334 for a transfer of 6.1 MVA

Needham 148-H6 to Baker Street 110 20-2407, 20-2405, 20-2406 via Station 20 as follows:
Close RADSEC* p24/129 and open Station breaker for a transfer of 4.7 MVA
*New RADSEC switch to be installed prior to June 2004.

Needham 148-H4 to Newton Highlands 292-H9 via close of RADSEC MRU 812 and open of RADSEC MRU 381 for a transfer of 2.9 MVA

Needham 148-H1 to Newton Highlands 292-H4 via close of RADSEC MRU 817 and open of RADSEC MRU 218 for a transfer of 2.9 MVA

Needham 148-H3 to Baker Street 110 20-2407, 20-2405, 20-2406 via Station 20 as follows:

Open RADSEC MRU 878 and close RADSEC MRU 931 for a transfer of 5.3 MVA
Open RADSEC MRU 610 and close RASDEC MRU 187 for a transfer of 1.7 MVA

Needham 148-H3 to Dover 456-H1 via close RADSEC MRU p9/2 and open RADSEC MRU p6/4 for a transfer of 2.5 MVA

Needham 148-H3 to Leland Street 240-H5 via close RADSEC MRU XXX p10/135 and open Station

breaker for a transfer of 2.0 MVA

Summary of Concerns: Needham Region

1. 14kV distribution circuit 148-H4 will be at its normal (2004)
2. 4 kV circuit 381-04 will reach near 100% of normal capacity (2004)
3. 148-H1 and 148-H6 will be over their normal (2008)

For any transformer outage, the remaining in-service transformer carries the full station load of 83.0 MVA. The station has 28 MVA of transfer capability to Station 240 Framingham, Station 456 Dover, Station 292 Newton and through the 24kV DSS system via Station 20 Dedham.
Without any significant major development projects during 2004-2008, the Needham Street Supply region is projected to experience modest load growth, approximately 1.4% annually. As a result of this small load growth, the Needham Station 148 will support the forecasted load growth in the supply region through 2008. In the summer of 2008 for the contingency outage of two transformers, Needham Station 148 will be loaded at 92% of the load carrying capability.

Distribution Systems

DSS Lines

There are four DSS supply lines supplied out of Needham Station 148. Two of the DSS lines are supply lines to Wellesley Municipal Light Plant in the Town of Wellesley and the other two lines supply NSTAR 4kV Station 381 located on the same property as Station 148. The table below summarizes the DSS line loading.

DSS Line	% of Normal 2004	LTE - % Load at Risk 2004	MVA at Risk 2004	LTE - % Load at Risk 2008	MVA at Risk 2008
378-90H*	87%	0%	0	0%	0
378-91*	86%	0%	0	0%	0
381-75 Alternate supply	0%	0%	0	0%	0
381-77	55%	0%	0	0%	0

Loading on Needham DSS lines. Those marked with an * feed Wellesley Municipal Light.

14kV Distribution

There are four 14 kV circuits supplied out of Needham Station 148. One of the four, circuit 148-H4 is projected to be at its normal rating in 2004. Circuits 148-H1 and 148-H4 are projected to at their normal ratings in 2008. The table below summarizes the 14kV circuit loading.

14 kV Circuit	% of Normal 2002	Projected % of Normal 2004	Projected % of Normal 2008
148-H1	89%	91%	**100%**
148-H3	66%	67%	74%
148-H4	98%	**100%**	**110%**
148-H6	93%	95%	**104%**

Loading on 14 kV distribution circuits.

4kV Substation

Needham Station 148 supplies two 14/4 kV stations, both stations are located on the same property as the bulk station: Chestnut Street Station 148 is projected to exceed the long-term emergency ratings. The table below summarizes the capacity of the 4 kV stations.

4 kV Station	2002 Peak (MVA)	LTE Capacity (MVA)	2004 Projection (MVA)	2008 Projection (MVA)
Chestnut St #148	8.2	7.2	8.4	8.7
Chestnut St #381	5.1	6.0	5.2	5.4

Loading on 4 kV stations fed from Needham #148

Proposed Integrated Plan

The suggested action in the table will address the concerns within the Needham supply region. Needham Sta #148 has adequate transformer capacity to support the projected meager load growth beyond 2008. Needham has two spare feeder positions that can support the installation of a new distribution circuit to relieve the heavily 14 kV distribution circuits. An alternative approach would be to increase the circuit capacity by reconductoring the heavily loaded circuits or transfer portion of the circuits to adjacent circuits within the supply region. The continued strategic conversions of portions of 4 kV circuits will reduced the projected overloads at Chestnut Street Sta #148 4 kV station.

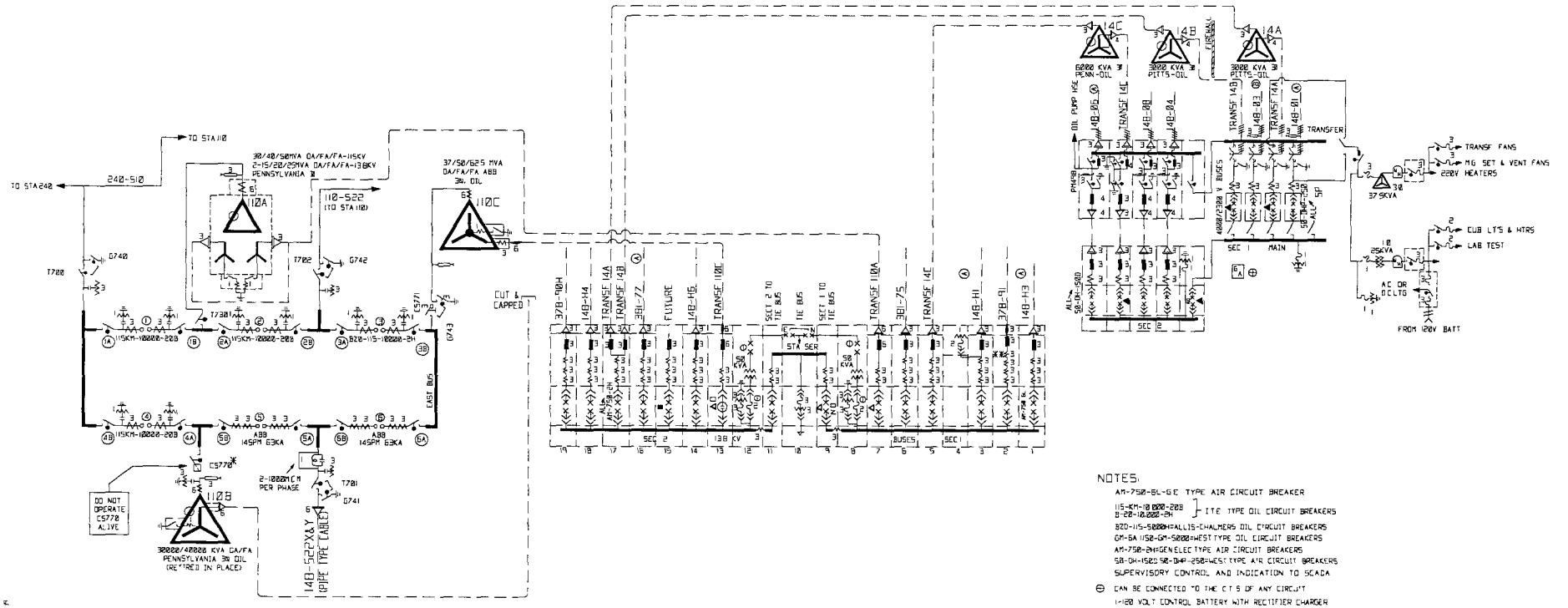
Action	Year needed	Estimated Cost
⇒ Relieve 14kV circuit 148-H1 and improve area circuit tie capacity	2004	$120K
⇒ Relieve 14kV circuit 148-H4 and improve area circuit tie capacity	2005	$200K
⇒ Relieve 14kV circuit 148-H6 by either the installation of a new distribution circuit or reconductoring the 148-H6 or load transfers to adjacent circuits.	2008	TBD

Recommended course of action for Needham Region

STATION 148

461 CHESTNUT ST
NEEDHAM

TEL # (617)541-7051



NOTES:

AM-750-BL-GE TYPE AIR CIRCUIT BREAKER

115-KM-100202-208 } ITE TYPE OIL CIRCUIT BREAKERS
B-20-100202-214

B20-115-5000=ALLIS-CHALMERS OIL CIRCUIT BREAKERS
GM-5A 1150-GM-5000=WEST TYPE OIL CIRCUIT BREAKERS
AM-750-2=GEN ELEC TYPE AIR CIRCUIT BREAKERS
5Ø-DH-1500 5Ø-DHP-250=WEST TYPE AIR CIRCUIT BREAKERS
SUPERVISORY CONTROL AND INDICATION TO SCADA

⊕ CAN BE CONNECTED TO THE CT'S OF ANY CIRCUIT

125 VOLT CONTROL BATTERY WITH RECTIFIER CHARGER

⊙ KEY INTERLOCKED-THE STA SER SEC BRKR MUST BE OPEN TO RELEASE THE KEY TO PERMIT THE PRIMARY FUSES TO BE WITHDRAWN FROM OPERATING POSITION

△ 4KV ABR SCHEME UPON LOSS OF TRANSF 110A OR 110B THE SUBJECT TRANSF'S SECONDARY BREAKER WILL OPEN AND THE SECT 1 TO TIE BUS BREAKER WILL CLOSE

▲ 4KV ABR SCHEME UPON LOSS OF EITHER TRANSF 14A B OR C THE SUBJECT TRANSFORMERS SECONDARY BREAKER WILL OPEN AND THE 4KV BUS TIE BREAKER WILL CLOSE

XX PRIMARY METERING CT's

X C5770 MANUALLY OPERATED (CRANK) MAKE DEAD TO OPERATE

145PM - ABB 3000A 63KA 5Ø BREAKER

■ GE-AM-38-750-200 AIR CIRCUIT BREAKER

□ GE-VB-138-750-3000 VACUUM CIRCUIT BREAKER

DATE	DESCRIPTION	BY	CHECK
6/17/08	REVISED DAG FROM ENGINEER'S MARK-UP	EBA	RM
5/3/22	REV SED DAC FROM ENGINEER'S MARK-UP	EBA	
6/7/22	UPDATED DRAWING FORM FIELD PRINTS	MJS	

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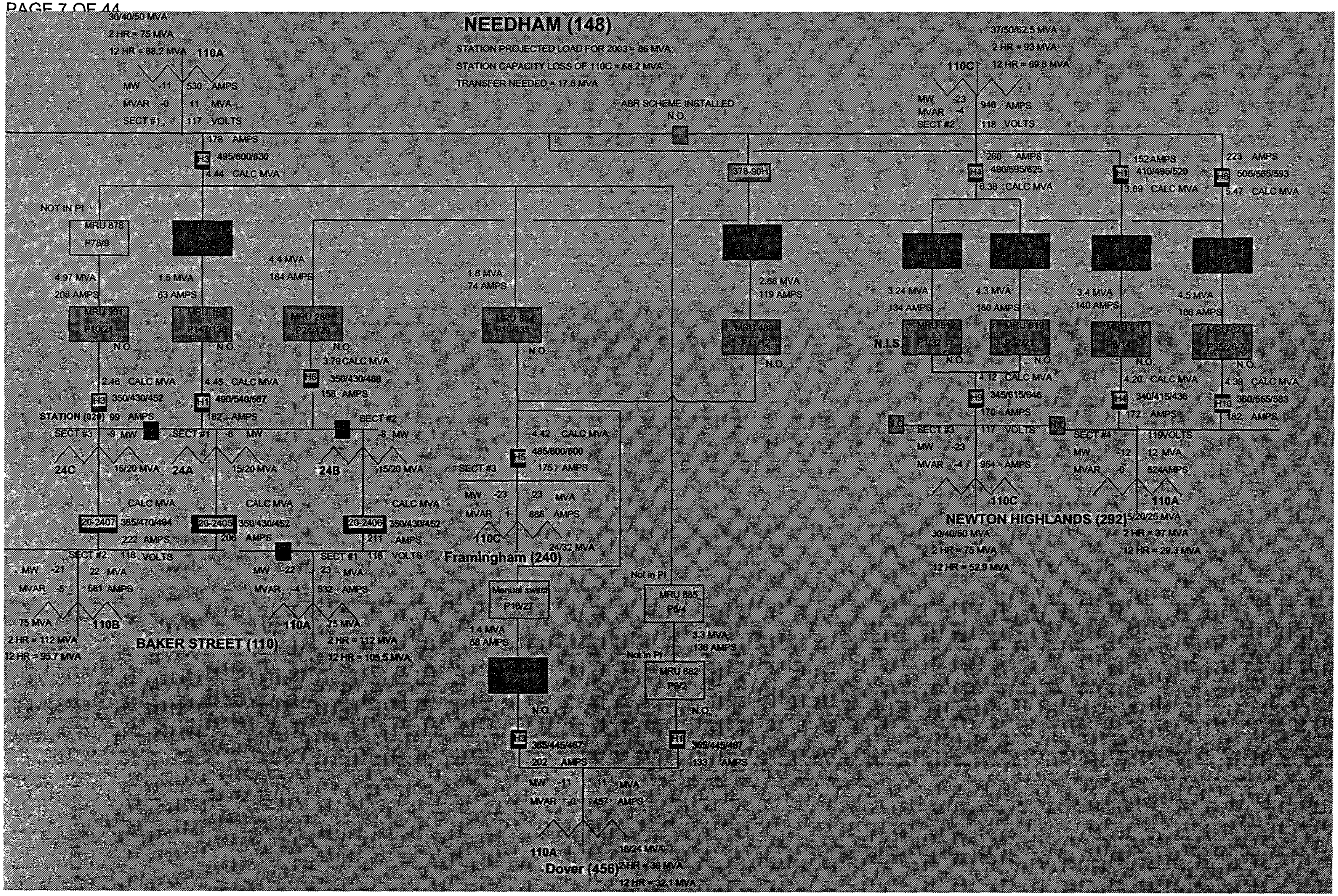

NEEDHAM (148)
STATION PROJECTED LOAD FOR 2003 = 86 MVA
STATION CAPACITY LOSS OF 110C = 68.2 MVA
TRANSFER NEEDED = 17.8 MVA
ABR SCHEME INSTALLED
N.O.
30/40/50 MVA
2 HR = 75 MVA
12 HR = 88.2 MVA
110A
MW -11
MVAR -0
SECT #1
530 AMPS
11 MVA
117 VOLTS
178 AMPS
495/600/630
4.44 CALC MVA
37/50/62.5 MVA
2 HR = 93 MVA
12 HR = 69.8 MVA
110C
MW -23
MVAR -4
SECT #2
948 AMPS
118 VOLTS
378-90H
260 AMPS
480/595/625
6.38 CALC MVA
152 AMPS
410/495/520
3.89 CALC MVA
223 AMPS
505/565/593
5.47 CALC MVA
NOT IN PI
MRU 878
P78/9
4.97 MVA
208 AMPS
MRU 931
P10/21
1.5 MVA
63 AMPS
4.4 MVA
184 AMPS
MRU 280
P24/129
1.8 MVA
74 AMPS
MRU 884
R10/335
2.88 MVA
119 AMPS
MRU 486
P11/12
3.24 MVA
134 AMPS
4.3 MVA
180 AMPS
3.4 MVA
140 AMPS
4.5 MVA
186 AMPS
N.I.S.
N.O.
2.46 CALC MVA
350/430/452
STATION (020) 99 AMPS
4.45 CALC MVA
490/540/567
182 AMPS
3.79 CALC MVA
350/430/488
158 AMPS
4.12 CALC MVA
345/615/646
170 AMPS
4.20 CALC MVA
340/415/436
172 AMPS
4.39 CALC MVA
360/555/583
182 AMPS
SECT #3 -9 MW
SECT #1 -8 MW
SECT #2 -8 MW
24C
24A
24B
15/20 MVA
CALC MVA
20-2407
385/470/494
222 AMPS
SECT #2
118 VOLTS
20-2405
350/430/452
206 AMPS
20-2406
350/430/452
211 AMPS
SECT #1
118 VOLTS
MW -21
MVAR -5
22 MVA
561 AMPS
75 MVA
2 HR = 112 MVA
12 HR = 95.7 MVA
110B
BAKER STREET (110)
MW -22
MVAR -4
23 MVA
532 AMPS
110A
75 MVA
2 HR = 112 MVA
12 HR = 105.5 MVA
4.42 CALC MVA
485/600/600
175 AMPS
SECT #3
MW -23
MVAR 1
23 MVA
688 AMPS
110C
24/32 MVA
Framingham (240)
SECT #3
117 VOLTS
MW -23
MVAR -4
954 AMPS
SECT #4
119VOLTS
MW -12
MVAR -6
12 MVA
624AMPS
110C
110A
NEWTON HIGHLANDS (292)
30/40/50 MVA
2 HR = 75 MVA
12 HR = 52.9 MVA
15/20/25 MVA
2 HR = 37 MVA
12 HR = 29.3 MVA
Manual switch
P16/27
1.4 MVA
58 AMPS
Not in PI
MRU 885
P9/4
3.3 MVA
138 AMPS
MRU 882
P9/2
385/445/467
202 AMPS
365/445/467
133 AMPS
MW -11
MVAR -0
11 MVA
457 AMPS
110A
18/24 MVA
2 HR = 36 MVA
12 HR = 32.1 MVA
Dover (456)

2003 T&D OPERATING STUDY
WALTHAM DISTRICT

STATION #282 WALTHAM

Waltham Station #282 supplies the communities of Waltham, Newton, and Weston. During the summer of 2002, Waltham peak load was 125 MVA.

Waltham Station #282 consists of three 115/13.8 kV transformers:

Transformer #110A: ABB 37/50/62.5 MVA 117/14.4 kV
Transformer #110B: Allis-Chalmers 60/80 [89.8] MVA 110/13.8/13.8 kV
Transformer #110C: General Electric 30/40 [44.8] MVA 110/13.8 kV

Waltham Station #282 has a total capacity of 193 MVA. NSTAR employs summer emergency rating (cyclic capability) for these three banks. Transformer 110A has a summer emergency rating of 69 MVA. Transformer 110B has a summer emergency rating of 96 MVA each. Transformer 110C has a summer emergency rating of 48 MVA. Station #282's firm capacity is 117 MVA. There is 22 MVA of RADSEC transfer switching capability to adjacent stations adjacent stations Lexington Station #320, Speen Street Station #433, Trapelo Road Station #450 and Watertown Station #467. Waltham's load carrying capability is 139 MVA.

Overload Ratings:

Transformer	Nameplate	12 hour LTE, 90F Ambient	12 hour LTE, 110F Ambient
110A	37/50/62.5 MVA	81 MVA	74 MVA
110B	60/80 [89.8] MVA	107 MVA	97 MVA
110C	30/40 [44.8] MVA	57 MVA	52 MVA

Station Capabilities:

Total Station Capacity (N)	Station Firm Capacity (LTE)	RADSEC Transfer	Manual Transfer	Total LCC
193 MVA	117 MVA	22 MVA	0 MVA	139 MVA

2004-2008 Projected load:

2004	2005	2006	2007	2008
139 MVA	140 MVA	141 MVA	143 MVA	145 MVA

Switching Actions:

Loss of Transformer #110A:

Open: Circuit Breakers #1 and #2 in Waltham 115kV Ring Bus
Main 110A 13.8kV Circuit Breaker
Disconnect Switch #T733
Close: ABR scheme closes 13.8V bus tie breakers automatically
Circuit Breakers #1 and #2 to restore Waltham 115kV Ring Bus

Loss of Transformer #110B:

Open: Circuit Breakers #9 and #12 in Waltham 115kV Ring Bus
Both Main 110B 13.8kV Circuit Breakers
Disconnect Switch #T731
Close: ABR scheme closes 13.8V bus tie breakers automatically
Circuit Breakers #9 and #12 to restore Waltham 115kV Ring Bus

Loss of Transformer #110C:

Open: Circuit Breakers #4 and #5 in Waltham 115kV Ring Bus
Main 110C 13.8kV Circuit Breaker
Disconnect Switch #T732
Close: ABR scheme closes 13.8V bus tie breakers automatically
Circuit Breakers #4 and #5 to restore Waltham 115kV Ring Bus

For loss of any transformer, transfer of the following DSS lines via RADSEC switches may also be required:

Waltham 282-H7 to Trapelo Rd. 450-H1 via RADSEC switches on P169/47 and P356/8-2 for a transfer of 4.2 MVA.

Waltham Station 33 Circuit 33-H2 to Trapelo Rd. 450-H6 via RADSEC switches on P334/36 and P472/8 for a transfer of 4.5 MVA

Waltham Station 33 Circuit 33-H2 to Watertown 467-H6 via RADSEC switches on P347/9 and P347/34 for a transfer of 1.5 MVA

Waltham 282-H9 to Watertown 467-H3 via RADSEC switches on P450/40 and P120/1 for a transfer of 3.0 MVA

Waltham 282-H2 to Trapelo Rd. 450-H2 via RADSEC switches on P538/6 and P538/8-7-1 for a transfer of 1.6 MVA

Waltham 282-H1 to Trapelo Rd. 450-H7 via RADSEC switches P8/38 and P10/2 for a transfer of 1.8 MVA

Waltham 282-H1 to Lexington 320-H6 via RADSEC switches on P30/65 and P30/21 for a transfer of 1.0 MVA

Waltham 282-H3 to Speen Street 433-H6 via RADSEC switches on P13/138 and P13/83 for a transfer of 4.4 MVA

Total Transfers (Maximum): 22.0 MVA

Summary of Concerns:

1. 14 kV Distribution circuits 33-H1 and 33-H2 are overloaded under normal conditions (2004).
2. 4 kV Auburn Street #316 overloaded under contingency conditions (2004)
3. Waltham Station #282 is overloaded --Inadequate transformer capacity under contingency conditions (2007)
4. Brandeis Line Group is overloaded under contingency conditions (2008)

Without any significant major development projects planned during the 2002-2008, the Waltham Supply region is projected to experience approximately 2.5 % load growth. Based on the load projections, by the summer of 2005 for a single contingency outage of transformer 110B, Waltham Station #282 will exceed the load carrying capability (1% over LTE, 1.0 MVA load risk). Between 2005-2008 there is the potential for 5 MVA of new load and the station could attain a loading of 105% of LCC. The load at risk would increase to 6 MVA.

Distribution Systems

DSS Lines

Waltham Station #282 has four line groups; Polaroid, Brandeis Waltham #1 and Waltham #2 line groups.

The Brandeis Line Group consists of DSS lines 386-1356 and 33-1363. The line group supplies Brandeis. Based on 2004 –2008 peak load projections, starting in 2008 summer the loss of 33-1363 DSS lines, the remaining DSS line will exceed the long-term emergency capacity (LTE).

The Polaroid Line Group consists of DSS lines 361-1359 and 361-1361. The line group supplies customer Stations #361. Upon the loss of either DSS lines, the remaining DSS line will not exceed the long-term emergency capacity (LTE), based on 2004-2008 peak load projections.

The Waltham #1 Line Group consists of three DSS lines 33-1350, 33-1353 and 33-1363. The line group supplies customer stations 206 and 527, and Bus section #1 at NSTAR Station #33 Pine Street, Waltham. Upon the loss of any of the DSS lines, the remaining DSS lines will not exceed the long-term emergency capacity (LTE), based on 2004-2008 peak load projections.

The Waltham #2 Line Group consists of three DSS lines 33-1351, 33-1352 and 33-1362. The line group supplies customer stations 249, and Bus section #2 at NSTAR Station #33 Pine Street, Waltham. Upon the loss of any of the DSS lines, the remaining DSS lines will not exceed the long-term emergency capacity (LTE), based on 2004-2008 peak load projections.

The following table provides details on the Waltham Station #282 line groups.

DSS Line	% of Normal 2004	LTE - % Load at Risk 2004	MVA at Risk 2004	LTE - % Load at Risk 2008	MVA at Risk 2008
33-1350	87%	0%	0	0%	0
33-1353	46%	0%	0	0%	0
33-1363	45%	0%	0	0%	0
33-1351	97%	0%	0	0%	0
33-1352	85%	0%	0	0%	0
33-1362	73%	0%	0	0%	0
361-1359	25%	0%	0	0%	0
361-1361	30%	0%	0	0%	0
386-1356	76%	0%	0	**6%**	**0.5**
33-1363	43%	0%	0	0%	0

Loading on Waltham #282 DSS lines

14 kV Distribution Circuits

There are eleven 14 kV distribution circuits within the Waltham Station #282 supply region. For the summer 2004 distribution circuits 33-H1 and 33-H2 are heavily loaded between 97%-99% of their normal capacity and will exceed their normal ratings in the 2005-2008 time frame. By 2008 four other distribution circuits will be heavily loaded by 2008. The loading on the 14 kV distribution circuits are shown in the table below:

14 kV Circuit	% of Normal 2002	Projected % of Normal 2004	Projected % of Normal 2008
282-H1	82%	**92%**	**96%**
282-H2	80%	89%	**92%**
282-H3	**91%**	86%	**90%**
282-H4	51%	57%	59%
282-H5	87%	89%	**93%**
282-H7	80%	85%	89%
282-H8	66%	73%	77%
282-H9	**92%**	88%	**93%**
33-H1	**94%**	**99%**	**104%**
33-H2	**92%**	**97%**	**101%**
33-H3	72%	76%	79%

Loading on Waltham supply region's 14 kV distribution circuits

4kV Station

Waltham #282 supplies two 4kV stations: Pine Street #33, Waltham and Auburn Street #316, Newton Station #277. Pine Street Station #33 is a four transformer station upon the loss of one of the four 14/4 kV transformers, the remaining transformers will not exceed its long-term emergency capacity.

Auburn Street Station #316 is a two transformer station upon the loss of either the 14/4 kV transformer, the remaining transformer will exceed its long-term emergency capacity.

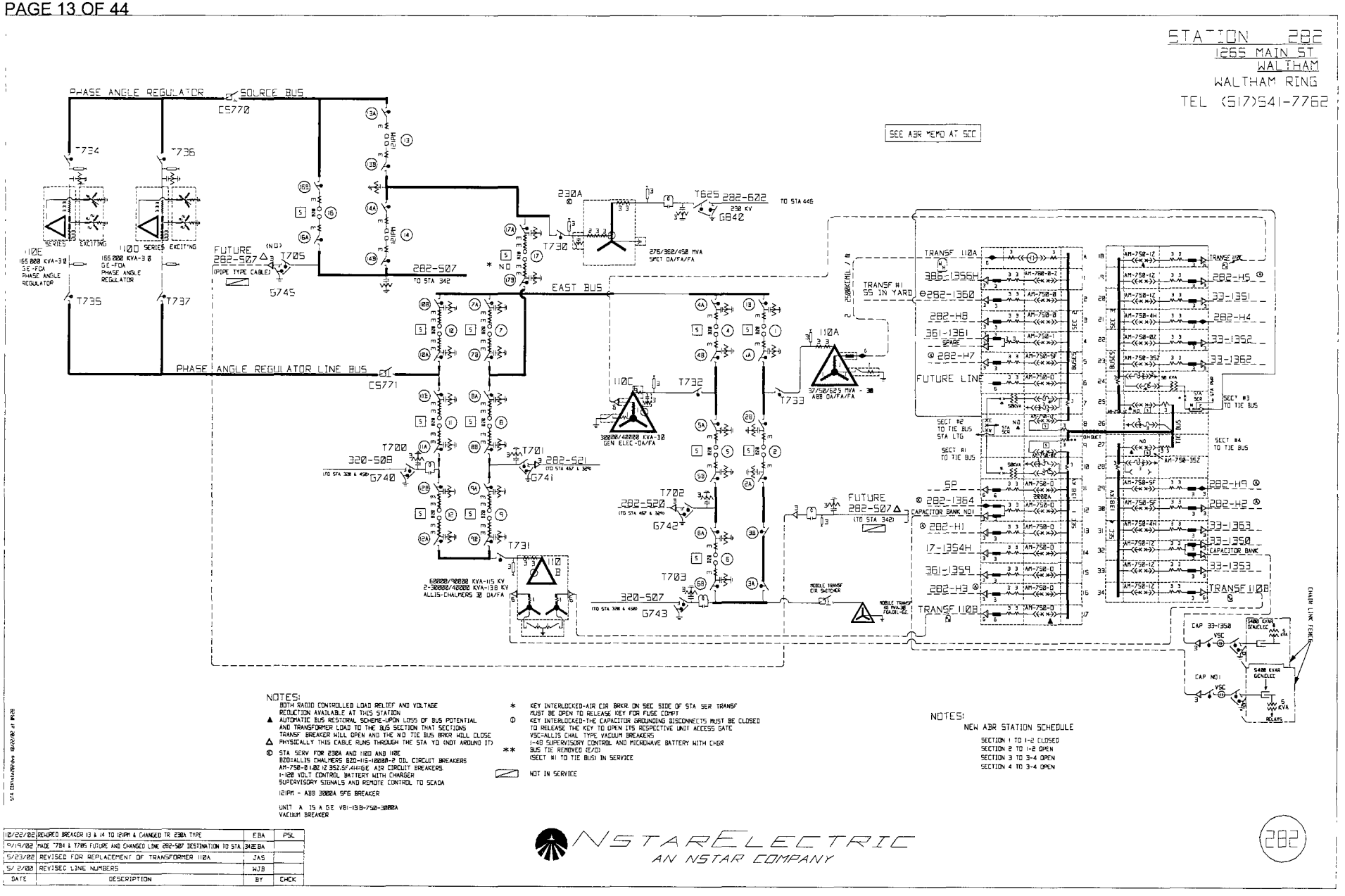
4 kV Station	2002 Peak (MVA)	LTE Capacity (MVA)	2004 Projection (MVA)	2008 Projection (MVA)
Pine St #33	10.2	14.5	10.4	10.9
Auburn St #316	7.3	6.0	7.4	7.7

Loading on 4 kV stations fed from Waltham #282

Proposed Integrated Plan

The suggested actions in the table will address the concerns within the Waltham supply region. The primary focus of the plan will be to increase the transformer capacity at Waltham Station #282 in a timely manner to support the region's load growth. Replacing the transformer 110C with new 62.5 MVA 115/14kV transformers will provide the foundation for all the Waltham area capacity needs beyond 2013. Alternative approach would be to either increase the transfer switching or transfer load to adjacent substations. A new circuit from Trapelo Road 450-H9 will be installed prior to the 2004 summer. This distribution circuit will relieve the Waltham Line Group and 14 kV distribution circuits 33-H2 and 320-H5. Reconductor 386-1356 of the heavily loaded Brandeis line group or a load transfer to an adjacent line. The remaining heavily loaded 14 kV distribution circuits will be relieve to the available capacity on adjacent distribution circuits.

Action	Year needed	Cost
⇒ Construct 450-H9 relieves 14 kV distribution circuits 320-H5 and the Waltham Line Group and 33-H2.	2004	$700K
⇒ Replace Waltham #282 transformer 110C with a new 62.5 MVA load tap changing transformer, or increase transfer switching or relive station by load transfer to adjacent stations.	2007	TBD
⇒ Reconductor DSS Line 386-1356 or load transfer to adjacent line	2008	TBD



NOTES:
BOTH RADIO CONTROLLED LOAD RELIEF AND VOLTAGE REDUCTION AVAILABLE AT THIS STATION
▲ AUTOMATIC BUS RESTORAL SCHEME-UPON LOSS OF BUS POTENTIAL AND TRANSFORMER LOAD TO THE BUS SECTION THAT SECTIONS TRANSF BREAKER WILL OPEN AND THE NO TIE BUS BRKR WILL CLOSE
△ PHYSICALLY THIS CABLE RUNS THROUGH THE STA YD (NOT AROUND IT)
◎ STA SERV FOR 230A AND 110D AND 110E
BZO=ALLIS CHALMERS BZO-115-12000-2 OIL CIRCUIT BREAKERS
AM-750-31.3Z 3SZ.SF.4H+GE AIR CIRCUIT BREAKERS
1-120 VOLT CONTROL BATTERY WITH CHARGER
SUPERVISORY SIGNALS AND REMOTE CONTROL TO SCADA
12IPM - ABB 3000A SF6 BREAKER
UNIT A 15 K GE VBI-138-750-3000A VACUUM BREAKER
* KEY INTERLOCKED-AIR CIR BRKR ON SEC SIDE OF STA SER TRANSF MUST BE OPEN TO RELEASE KEY FOR FUSE COMPT
Ø KEY INTERLOCKED-THE CAPACITOR GROUNDING DISCONNECTS MUST BE CLOSED TO RELEASE THE KEY TO OPEN ITS RESPECTIVE UNIT ACCESS GATE
VSC=ALLIS CHAL TYPE VACUUM BREAKERS
1-48 SUPERVISORY CONTROL AND MICROWAVE BATTERY WITH CHGR
** BUS TIE REMOVED (E/D)
(SECT #1 TO TIE BUS) IN SERVICE
NOT IN SERVICE

NOTES:
NEW ABR STATION SCHEDULE
SECTION 1 TO 1-2 CLOSED
SECTION 2 TO 1-2 OPEN
SECTION 3 TO 3-4 OPEN
SECTION 4 TO 3-4 OPEN

DATE	DESCRIPTION	BY	CHCK
10/22/02	REWIRED BREAKER 13 & 14 TO 12IPM & CHANGED TR 230A TYPE	EBA	PSL
9/19/02	MADE 784 & T705 FUTURE AND CHANGED LINE 282-507 DESTINATION TO STA 342	EBA	
5/23/02	REVISED FOR REPLACEMENT OF TRANSFORMER 110A	JAS	
5/2/02	REVISED LINE NUMBERS	WJB	

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282

2003 T&D OPERATING STUDY
WALTHAM DISTRICT

STATION #292 NEWTON HIGHLANDS

Newton Highland Station 292 serves a power supply area consisting of Newton, portions of Needham and Wellesley Municipal Light. Newton Highland Station 292 consists of three 115/13.8 kV step-down transformers:

Transformer #110A: McGraw-Edison 30/40/50 [56] MVA 115/13.8/13.8 kV
Transformer #110B: McGraw-Edison 30/40/50 [56] MVA 115/13.8/13.8 kV
Transformer #110C: Westinghouse 60/80/100 MVA 115/13.8/13.8 kV

Newton Highland Station 292 total capacity is 212 MVA. NSTAR employs summer emergency rating (cyclic capability) of 144 MVA. Station 292 has approximately 25 MVA of transfer switching to Stations 148 Needham, 282 Waltham, 329 Brighton and 467 Watertown. Newton Highland's load carrying capability is 169 MVA.

Overload Ratings:

Transformer	Nameplate	12 hour LTE, 90F Ambient	12 hour LTE, 110F Ambient
110A	30/40/50 [56] MVA	66 MVA	61 MVA
110B	30/40/50 [56] MVA	72 MVA	67 MVA
110C	60/80/100 MVA	108 MVA	99 MVA

Station Capabilities:

Total Station Capacity (N)	Station Firm Capacity (LTE)	RADSEC Transfer	Manual Transfer	Total LCC
212 MVA	144 MVA	25.5 MVA	0 MVA	169 MVA

Station Load Forecast:

2004	2005	2006	2007	2008
168 MVA	170 MVA	171 MVA	174 MVA	176 MVA

Switching Actions:

Loss of Transformer #110A:

Open: Circuit Switcher #CS770
Both Main 110A 13.8kV Circuit Breakers
Close: ABR scheme closes 13.8V bus tie breakers automatically

Loss of Transformer #110B:

Open: Circuit Switcher #CS771
Both Main 110B 13.8kV Circuit Breakers
Close:ABR scheme closes 13.8V bus tie breakers automatically

Loss of Transformer #110C:

Open: Circuit Switcher #CS772
Both Main 110C 13.8kV Circuit Breakers
Close: ABR scheme closes 13.8V bus tie breakers automatically

Transfer Switching:
For either transformer outage, the remaining in-service transformer with transfer switching supports the full station load of 168.0 MVA, the station at 99% of the station's load carrying capability.

Newton 292-H7 to Waltham (282) 33-H3 via RADSEC switches on P223/18 and P475/9 for a transfer of 4.2 MVA.

Newton 292-H5 to Brighton 329-H6 via RADSEC switches on P18/118 and P86/24 for a transfer of 3.2 MVA.

Newton 292-H8 to Watertown 467-H14 via a RADSEC switch on P73/82 and Station Breaker (292-H8) at Station #292 for a transfer of 4.5 MVA.

Newton Station 17 Circuit 17-H2 to Watertown 467-H14 via RADSEC switch on P413/1 and Station Breaker (17-H2) at Station #17 for a transfer of 1.7 MVA

Newton 292-H9 to Needham 148-H4 via a RADSEC switches on P1/32 and P148/3 for a transfer of 2.4 MVA.

Newton Station 17 Circuit 17-H1 to Waltham 282-H9 via RADSEC switch on P450/82A and Station Breaker (17-H1) at Station #17 for a transfer of 3.3 MVA

Newton 292-H3 to Needham 148-H6 via RADSEC switches on P6/56 and P1365/0 for a transfer of 2.6 MVA.

Newton 292-H2 to Waltham 282-H8 via RADSEC switches on P103/28 and P447228A for a transfer of 2.0 MVA.

Newton 292-H4 to Needham 148-H1 via RADSEC switches on P8/14 and P8/9A for a transfer of 1.6 MVA.

Total Transfers (Maximum): 25.5 MVA

Summary of Concerns Newton Region

1. Newton #292 load is projected to exceed its load carrying capability (2005)
2. 292-H2 and 292-H3 are loaded at 94% of normal rating (2004)
3. Newton line group has load at risk under an N-1 condition (2004)
4. 4 kV circuit 292-01 is overloaded

No major development is expected in the Newton Supply area between 2004-2008, the region is projected to experience meager load growth load growth, approximately 1.1% annually. For any transformer outage, the remaining in-service transformers carries full station load of 168.0 MVA. For the loss of transformer 110C Newton Highland 's load carrying capability of 168 MVA is adequate to serve the projected 2004. The station requires 25 MVA of transfer switching to other stations to meet the power requirements for the area. Based on the 2004 – 2008 load forecast the station is projected to exceed its load carrying capability beginning in 2005 with 170 MVA of anticipated peak load.

Distribution Systems

DSS Lines

The Newton line group serves the three 4kV substations (Stations 17, 292, and 369) supplied out of Station 292. The line group is a concern due to heavy loading. Two of the five lines are projected to overload during normal conditions in 2004, and all but one will have load at risk in an N-1 situation. Details on the DSS line loading are shown in the table below.

DSS Line	% of Normal 2004	LTE - Load at Risk 2004	LTE - Load at Risk 2008
453-214X	111%	4%	13%
41-211X	66%	47%	59%
292-82H	109%	35%	40%
292-215	98%	46%	51%
292-213X	94%	0%	0%

Loading on Newton line group

14kV Distribution

There are twelve 14kV radial lines fed from Newton Highland Station 292 and all are is projected to exceed its normal rating in 2004; 483-H4. Circuits 483-H1 and H2 exceeded their normal rating in 2002 and are being relieved as part of a 2003 Dorchester distribution capacity improvement project The remaining Dorchester distribution circuits have adequate capacity.

Newton #292 14 kV circuits are generally have light to moderate loads, with the exception of 292-H2 and 292-H3, which are projected to be around 94% in 2004 and will reach full capacity in 2008 or 2009.

14 kV Circuit	% of Normal 2002	Projected % of Normal 2004	Projected % of Normal 2008
17-H1	32%	33%	35%
17-H2	34%	35%	37%
292-H1	55%	54%	57%
292-H2	96%	94%	98%
292-H3	96%	94%	99%
292-H4	71%	69%	73%
292-H5	68%	66%	69%
292-H6	91%	89%	93%
292-H7	91%	87%	91%
292-H8	94%	54%	58%
292-H9	71%	70%	73%
292-H10	73%	72%	75%
292-H11	85%	83%	87%

Loading on Newton #292 14kV circuits

4kV Substation

Newton Highland Station 292 feeds three 4 kV stations: Homer Street Station 17, Elliot Street Station 292 and Jackson Street Station 369. The loads at all of the 4kV stations are projected to have marginal load increases over the next 5 years. Details on the loading of the 4 kV stations are detailed in the table below.

4kV Station	2002 Peak (MVA)	LTE Capacity (MVA)	2004 Projection (MVA)	2008 Projection (MVA)
Homer St #17	12.9	18.0	13.2	13.3
Elliot St #292	5.1	6.0	5.1	5.2
Jackson St #369	4.4	6.0	4.5	4.7

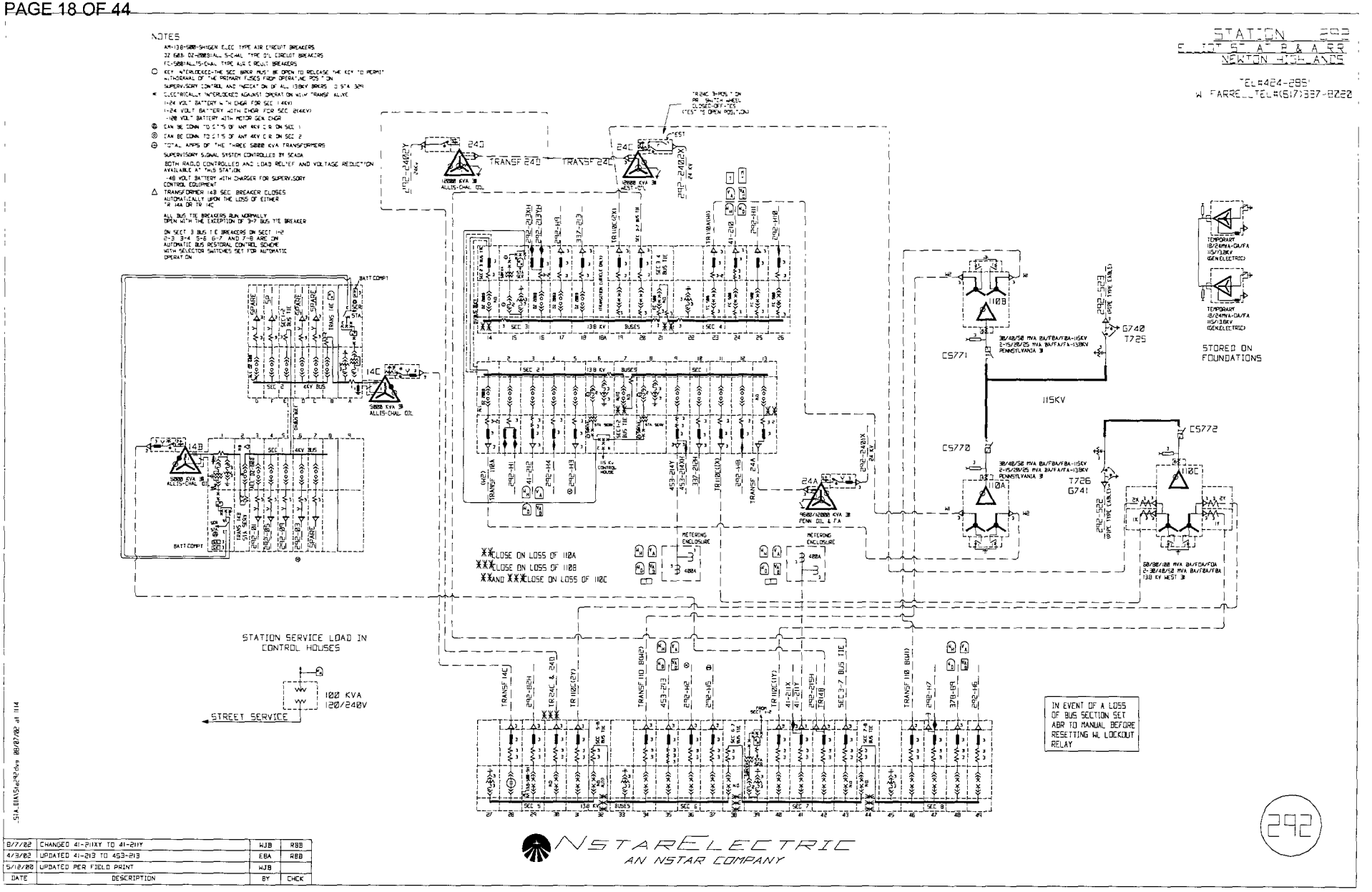
Newton 4 kV station loading

Proposed Integrated Plan

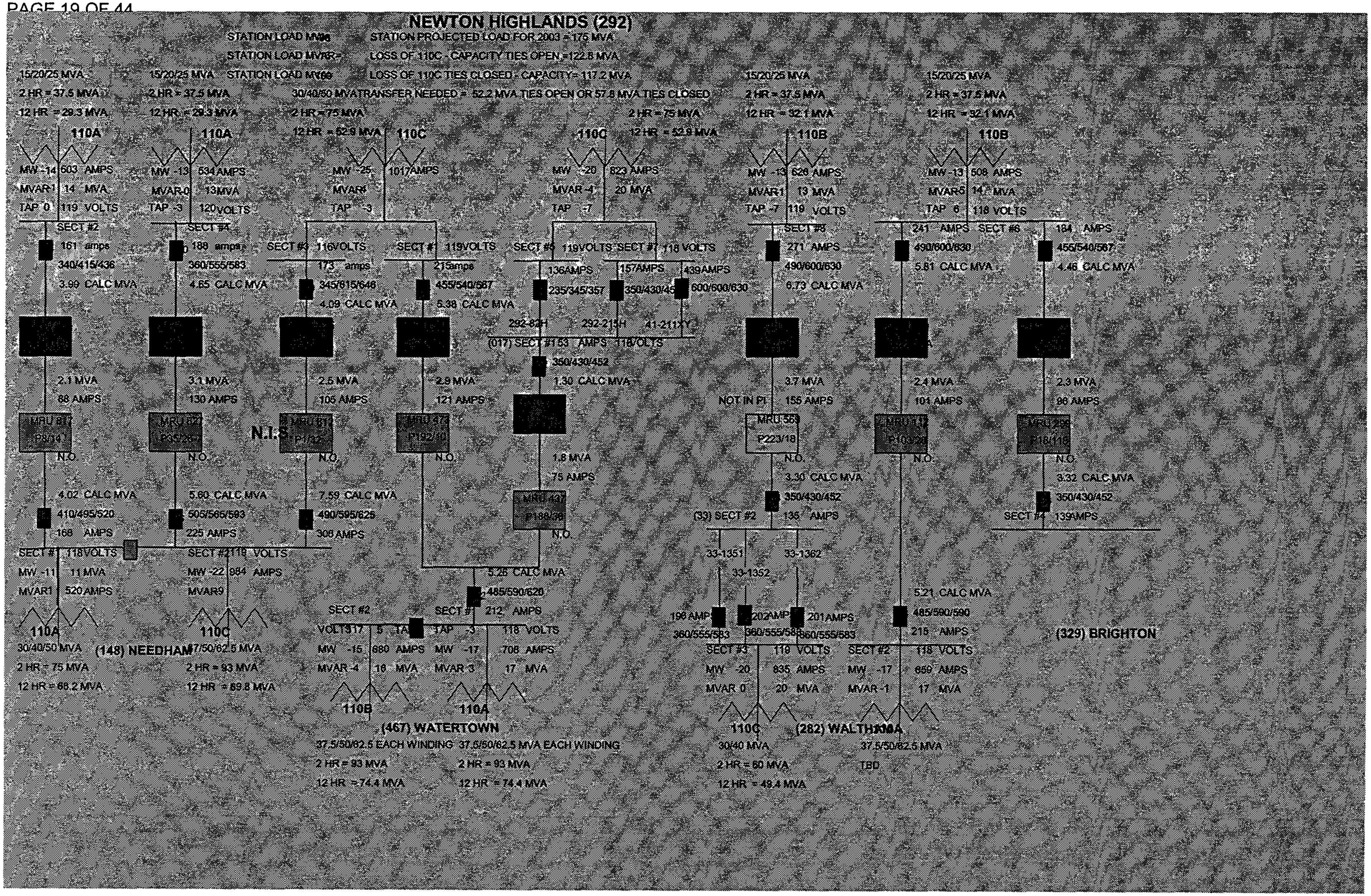
The suggested actions listed in the table below will address all of the capacity concerns in the region. The establishment of a new circuit from Watertown Station 467 will reduce loading on the Newton line group and will establish an additional transfer point between Stations 292 and 467. The new transfer capacity gained by establishing new circuit 467-H14 is expected to defer the need for a major substation addition in the Newton region beyond 2008. Strategic additions of transfer capability between adjacent stations, Stations 148, 282, 329 and 467 in the Newton area will continue to implemented. The long-tem plan for the Newton supply area is the construction of a new 115/14kV substation to meet the power supply needs of the area; the need for this new station is projected for 2008. An alternative would to transfer load to adjacent stations to relieve the heavy loading conditions at Newton Station #292.

Action	Year needed	Estimated Cost
⇒ Establish new circuit 467-H14 to relieve the Newton Line Group	2004	$100K
⇒ New Colburn Street Substation – Improves transmission in area - **see Brighton**	2004 - 05	
⇒ New station on NSTAR property in Newton, or load transfer to adjacent substations	2008	$TBD

Recommended course of action for Newton Supply Region



DATE	DESCRIPTION	BY	CHK
8/7/02	CHANGED 41-211XY TO 41-211Y	WJB	RBB
4/3/02	UPDATED 41-213 TO 453-213	EBA	RBB
5/12/00	UPDATED PER FIELD PRINT	WJB	


NEWTON HIGHLANDS (292)
STATION LOAD MW
STATION LOAD MVAR
STATION LOAD MVA
STATION PROJECTED LOAD FOR 2003 = 175 MVA
LOSS OF 110C - CAPACITY TIES OPEN =122.8 MVA
LOSS OF 110C TIES CLOSED - CAPACITY= 117.2 MVA
30/40/50 MVATRANSFER NEEDED = 52.2 MVA TIES OPEN OR 57.8 MVA TIES CLOSED
15/20/25 MVA
2 HR = 37.5 MVA
12 HR = 29.3 MVA
110A
MW -14 603 AMPS
MVAR1 14 MVA
TAP 0 119 VOLTS
SECT #2
161 amps
340/415/436
3.99 CALC MVA
2.1 MVA
88 AMPS
N.O.
4.02 CALC MVA
410/495/520
168 AMPS
SECT #1 118VOLTS
MW -11 11 MVA
MVAR1 520 AMPS
110A
30/40/50 MVA
2 HR = 75 MVA
12 HR = 68.2 MVA
(148) NEEDHAM
15/20/25 MVA
2 HR = 37.5 MVA
12 HR = 29.3 MVA
110A
MW -13 534 AMPS
MVAR 0 13MVA
TAP -3 120VOLTS
SECT #4
188 amps
360/555/583
4.65 CALC MVA
3.1 MVA
130 AMPS
N.O.
5.60 CALC MVA
505/565/593
225 AMPS
SECT #2 118 VOLTS
MW -22 984 AMPS
MVAR9
110C
37/50/62.5 MVA
2 HR = 93 MVA
12 HR = 89.8 MVA
N.I.S
2 HR = 75 MVA
12 HR = 52.9 MVA
110C
MW -25 1017AMPS
TAP -3
SECT #3 116VOLTS
173 amps
345/615/646
4.09 CALC MVA
2.5 MVA
105 AMPS
N.O.
7.59 CALC MVA
490/595/625
306 AMPS
SECT #1 119VOLTS
215amps
455/540/567
5.38 CALC MVA
2.9 MVA
121 AMPS
N.O.
110C
2 HR = 75 MVA
12 HR = 52.9 MVA
MW -20 823 AMPS
MVAR -4 20 MVA
TAP -7
SECT #5 119VOLTS
SECT #7 118 VOLTS
136AMPS
235/345/357
157AMPS
350/430/45
439AMPS
600/600/630
292-82H
292-215H
41-211XY
(017) SECT #1 53 AMPS 118VOLTS
350/430/452
1.30 CALC MVA
1.8 MVA
75 AMPS
N.O.
5.26 CALC MVA
485/590/620
SECT #2
SECT # 212 AMPS
VOLTS 117
TAP -3 118 VOLTS
MW -15 880 AMPS
MVAR -4 18 MVA
MW -17 708 AMPS
MVAR 3 17 MVA
110B
110A
(467) WATERTOWN
37.5/50/62.5 EACH WINDING
37.5/50/62.5 MVA EACH WINDING
2 HR = 93 MVA
12 HR = 74.4 MVA
15/20/25 MVA
2 HR = 37.5 MVA
12 HR = 32.1 MVA
110B
MW -13 626 AMPS
MVAR1 13 MVA
TAP -7 119 VOLTS
SECT #8
271 AMPS
490/600/630
6.73 CALC MVA
3.7 MVA
155 AMPS
NOT IN PI
P223/18
N.O.
3.30 CALC MVA
350/430/452
(33) SECT #2 136 AMPS
33-1351
33-1352
33-1362
198 AMPS
360/555/583
202AMPS
201AMPS
SECT #3 119 VOLTS
MW -20 835 AMPS
MVAR 0 20 MVA
110C
30/40 MVA
2 HR = 60 MVA
12 HR = 49.4 MVA
(282) WALTHAM
15/20/25 MVA
2 HR = 37.5 MVA
12 HR = 32.1 MVA
110B
MW -13 508 AMPS
14 MVA
TAP 6 118 VOLTS
241 AMPS
SECT #6
490/600/630
5.81 CALC MVA
2.4 MVA
101 AMPS
N.O.
5.21 CALC MVA
485/590/590
215 AMPS
SECT #2 118 VOLTS
MW -17 659 AMPS
MVAR -1 17 MVA
37.5/50/62.5 MVA
TBD
184 AMPS
455/540/567
4.46 CALC MVA
2.3 MVA
96 AMPS
N.O.
3.32 CALC MVA
350/430/452
SECT #4 139AMPS
(329) BRIGHTON

2003 T&D OPERATING STUDY
WALTHAM DISTRICT

STATION #320 LEXINGTON

The Lexington Station #320 serves a power supply area consisting of portions of the towns of Lincoln, Lexington, and part of the city of Waltham. During the summer of 2002, Lexington peak load was 64 MVA.

Lexington Station #320 consists of two 115/13.8 kV transformers:

Transformer #110A: Westinghouse 60/80 [89.6] MVA 115/13.8/13.8 kV
Transformer #110B: Westinghouse 60/80 [89.6] MVA 115/13.8/13.8 kV (A)

(A) Bus Section #3 was destroyed in a fire, Transformer 110B has only one winding in-service.

Lexington Station #320 total capacity is 120 MVA. NSTAR employs summer emergency rating (cyclic capability) for each of these two banks. Transformers 110A has a summer emergency rating of 100 MVA. Transformer 110B has a summer emergency rating of 54 MVA. Station #320's firm capacity is 54 MVA. Lexington Station #320 has approximately 25 MVA of RADSEC transfer switching to adjacent stations Waltham Station #282, Trapelo Road Station #450 and Hartwell Avenue #533. Lexington's load carrying capability is 79 MVA.

Overload Ratings:

Transformer	Nameplate	12 hour LTE, 90F Ambient	12 hour LTE, 110F Ambient
110A	60/80 [89.6] MVA	120 MVA	109 MVA
110B	30/40 MVA	60 MVA	54 MVA

Station Capabilities:

Total Station Capacity (N)	Station Firm Capacity (LTE)	RADSEC Transfer	Manual Transfer	Total LCC
120 MVA	54 MVA	25 MVA	0 MVA	79 MVA

2004-2008 Projected load:

2004	2005	2006	2007	2008
72 MVA	73 MVA	73 MVA	75 MVA	76 MVA

Switching Actions:

Loss of Transformer #110A:

Open: Circuit Breakers #1 and #2 in Lexington 115kV Ring Bus

Both Main 110A 13.8kV Circuit Breakers
Disconnect Switch #T730

Close: Close 13.8kV Bus Tie Breaker
Circuit Breakers #1 and #2 in Lexington 115kV Ring Bus

Loss of Transformer #110B:

Open: Circuit Breakers #4 and #5 in Lexington 115kV Ring Bus
Both Main 110B 13.8kV Circuit Breakers
Disconnect Switch #T731

Close: Close 13.8kV Bus Tie Breaker
Circuit Breakers #4 and #5 in Lexington 115kV Ring Bus

For loss of any transformer, transfer of the following DSS lines via RADSEC switches may also be required:

Lexington 320-H1 to Waltham 282-H1 via RADSEC switches on P 30/65 and P22/85 for a total transfer of 4.4 MVA

Lexington 320-H2 to Hartwell Ave. 533-H4 via RADSEC MRU 905 on P 57/168 for a transfer of 3.7 MVA.

Lexington 320-H2 to Trapelo Road 450-H5 via RADSEC switches on P 90/36A and P193/94 for a total transfer of 6.0 MVA

Lexington 320-H3 to Trapelo Road 450-H3 via RADSEC switches on P15/5 for a transfer of 3.8 MVA.

Lexington 320-H3 to Trapelo Road 450-H7 via RADSEC switches on P15/5 for a transfer of 3.8 MVA.

Lexington 320-H5 to Trapelo Road 450-H6 via RADSEC switches on P 110/36A and P21/3 for a transfer of 3.3 MVA.

Total Transfer: 25.0 MVA

Summary of Concerns:

1. Circuits 320-H5 will exceed 100% of Normal Rating for all lines in (2004)
2. Circuits 34-01 (2004) will exceed 100% of Normal Rating and 34-05 will be heavily loaded (2008)

Without any significant major development projects planned during the 2004-2008, the Lexington Supply region is projected to experience modest load growth; approximately 1.3%. Based on the load projections, by the summer of 2008 for a single contingency outage of either transformer 110A or 110B, though heavily loaded Lexington Station #320 would have adequate capacity to meet the load requirements; 96% of the load carrying capability.

Distribution Systems

DSS Lines

Lexington Station #320 supplies the Lexington line group.

The Lexington Line Group consists of DSS lines 34-1351H, 34-1352H and 34-1385H. The line group supplies NSTAR Grant Street, Lexington Station #34. All the lines have distribution circuits tapped off the lines. Upon the loss of any DSS lines, the remaining DSS lines will not exceed the long-term emergency capacity (LTE), based on 2004-2008 peak load projections.

DSS Line	% of Normal 2004	LTE - % Load at Risk 2004	MVA at Risk 2004	LTE - % Load at Risk 2008	MVA at Risk 2008
34-1351	70%	0%	0	0%	0
34-1352	60%	0%	0	0%	0
34-1385	94%	0%	0	0%	0

Loading on Lexington #320 DSS lines.

14 kV Distribution Circuits

There are six 14 kV distribution circuits supplied by Lexington Station #320. The distribution circuit 320-H5 is expected to exceed the normal capacity in 2004. Loading on the 14 kV distribution circuits are shown in the table below:

14 kV Circuit	% of Normal 2002	Projected % of Normal 2004	Projected % of Normal 2008
320-H1	**103%**	85%	92%
320-H2	63%	84%	88%
320-H3	0%	78%	78%
320-H4	39%	44%	46%
320-H5	81%	**109%**	**114%**
320-H6	71`%	79%	84%

Loading on Lexington #320 14 kV distribution circuits

4kV Station

Lexington #320 supplies Grant Street Station# 34. Both Station #124 and #277 are three 14/4 kV transformer stations. Upon the loss of one of the three 14/4 kV transformers, the remaining transformers will not exceed its long-term emergency capacity. There is no load at risk for this event at the 4kV station.

4 kV Station	2002 Peak (MVA)	LTE Capacity (MVA)	2004 Projection (MVA)	2008 Projection (MVA)
Grant Street, #34	12.5	13.5	12.7	13.1

Loading on 4 kV station fed from Lexington Sta #320

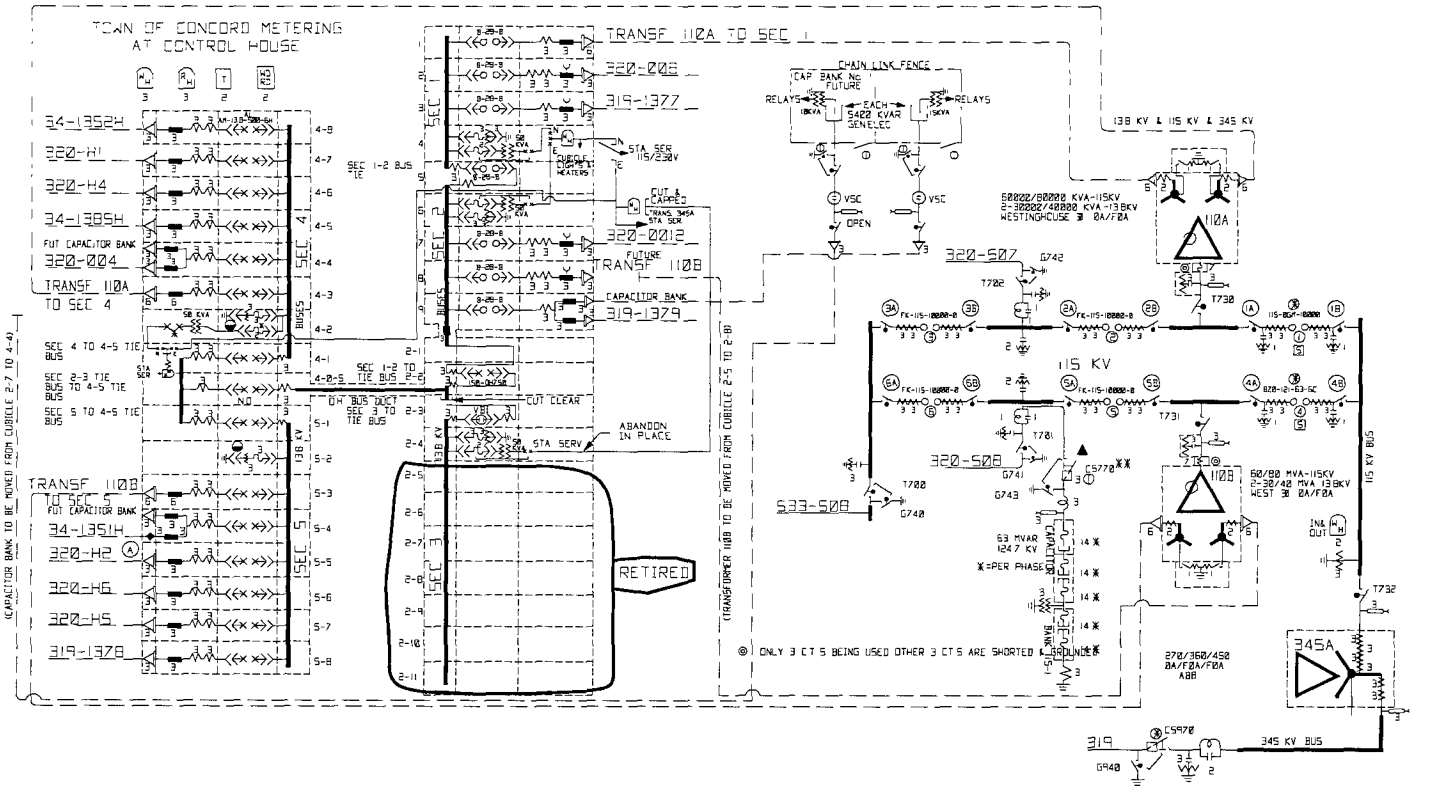
Proposed Integrated Plan

The suggested actions in the table will address the concerns within the Lexington supply region. Lexington Sta #320 has adequate transformer capacity to support the projected meager load growth through 2008. A new circuit from Trapelo Road 450-H9 will be installed prior to the 2004 summer. This distribution circuit will relieve the Waltham Line Group and 14 kV distribution circuits 33-H2

and 320-H5.

Action	Year needed	Cost
⇒ Construct 450-H9 relieves 14 kV distribution circuits 320-H5 and the Waltham Line Group and 33-H2.	2004	$700K

STATION 320
OFF MARRETT ROAD
LEXINGTON
LEXINGTON RING



NOTES:
- 870-131-69-6C = ALLIS CHALMERS TYPE OIL CIRCUIT BREAKER
- B-DB-B=WEST TYPE OIL CIRCUIT BREAKERS
- VBI = GE VACUUM BREAKERS
- AM-138-500-6H GENERAL ELECTRIC TYPE AIR CIRCUIT BREAKERS
- 138-DH75M=WEST TYPE AIR CIRCUIT BREAKERS
- VSC=ALLIS CHAL TYPE VACUUM BREAKERS
- SUPERVISORY CONTROL AND TELEMETERING SYSTEM TO SEC
- FK-115-40000-B4GE TYPE OIL CIRCUIT BREAKER
- 1-130 VOLT CONTROL BATTERY WITH CHARGER
- Ⓘ KEY INTERLOCKED-THE CAPACITOR GROUND DISCONNECTS MUST BE CLOSED TO RELEASE THE KEY TO OPEN 115 RESPECTIVE UNIT ACCESS GATE

- ** DO NOT OPERATE CS770 WHEN ENERGIZED
- 1-48 VOLT SUPERVISORY CONTROL BATTERY WITH CHARGER
- BOTH RADIO CONTROLLED LOAD RELIEF AND VOLTAGE REDUCTION AVAILABLE AT THIS STATION
- 115-0GM-10000=WESTINGHOUSE TYPE OIL CIRCUIT BREAKER
- Ⓚ ELECTRICAL INTERLOCK-BREAKERS 1 & 4 MUST BE OPEN BEFORE CIRCUIT SWITCHER CAN BE OPENED
- ◒ NON-STANDARD BUS POTENTIAL TRANSFORMERS RATIO 12121
- * KEY INTERLOCKED-THE STA SERV SEC AIR BRK MUST BE OPEN TO PERMIT WITHDRAWAL OF THE PRI FUSES FROM OPERAT POSITION

- Ⓘ CIRCUIT SWITCHER EQUIPPED WITH SHUNT TRIP DEVICE
- ▲ DO NOT CLOSE CIRCUIT SWITCHER MANUALLY WHEN ENERGIZED
- *** TEMP STATION SERVICE SUPPLY FROM CIRCUIT 320-H4

DATE	DESCRIPTION	BY	CHK
8/28/02	ADDED MISSING BREAKERS TO CUBICLE 5-6 & 5-8	EBA	RBB
1/23/01	UPDATED TRANSF 345A AND LINES IN CUB 2 & 7	WJB	EFL

NSTAR ELECTRIC
AN NSTAR COMPANY

320

2003 T&D OPERATING STUDY
WALTHAM DISTRICT

STATION #391 BURLINGTON

Burlington Station #391 supplies the towns of Burlington and portions of Lexington and Woburn. During the summer of 2002, Burlington peak load was 109 MVA.

Burlington Station #391 consists of two 115/13.8 kV transformers:

Transformer #110A: Westinghouse 60/80 [89.6] MVA 115/13.8/13.8 kV
Transformer #110B: Westinghouse 60/80 [89.6] MVA 115/13.8/13.8 kV

Burlington Station #391 total capacity is 160 MVA. NSTAR employs summer emergency rating (cyclic capability) of 99.9 MVA for each of these two banks. Station #391's firm capacity is 100 MVA. Burlington Station #391 has approximately 15.1 MVA of RADSEC transfer switching to adjacent stations Woburn #211, North Woburn #375 and Hartwell Avenue Station #533. There is approximately 7.3 MVA of manual transfer switching between Burlington Station #391 and Hartwell Avenue Station #533. Burlington's load carrying capability is 122.4 MVA.

Overload Ratings:

Transformer	Nameplate	12 hour LTE, 90F Ambient	12 hour LTE, 110F Ambient
110A	60/80 [89.6] MVA	120 MVA	109 MVA
110B	60/80 [89.6] MVA	119 MVA	108 MVA

Station Capabilities:

Total Station Capacity (N)	Station Firm Capacity (LTE)	RADSEC Transfer	Manual Transfer	Total LCC
160 MVA	100 MVA	15.1 MVA	7.3 MVA	122.4 MVA

2004-2008 Projected load:

2004	2005	2006	2007	2008
118 MVA	118 MVA	120 MVA	122 MVA	124 MVA

Switching Actions:

Loss of Transformer #110A:

Open: Circuit Switcher #CS773
Both Main 110A 13.8kV Circuit Breakers
Close: ABR scheme closes 13.8kV Bus Ties Automatically

Loss of Transformer #110B:

Open: Circuit Switcher #CS772
Both Main 110B 13.8kV Circuit Breakers
Close: ABR scheme closes 13.8kV Bus Ties Automatically

For loss of any transformer, transfer of the following DSS lines via RADSEC switches may also be required:

Burlington 391-H11 to Woburn 351-1385H via RADSEC MRU 111 on P 176/5 for a transfer of 4 MVA
Burlington 391-H11 to Woburn 211-H10 via RADSEC switches on P431/6 and P27/44 for a transfer of 2.8 MVA
Burlington 391-H3 to Hartwell Ave. 533-H4 via RADSEC MRU 049 on P 83/17 and a manual switch on P 1/3 for a transfer of 0.6 MVA
Burlington 391-H10 to Hartwell Ave. 345-1379H1 via manual switch on P84/29 for a transfer of 6.7 MVA
Burlington 391-H7 to Hartwell Ave. 487-1376H via RADSEC switches on P84/28 and P84/10 for a transfer of 1.8 MVA
Burlington 391-H8 to Hartwell Ave. 533-H7 via RADSEC MRU 577 on P146/13 for a transfer of 3.2 MVA
Burlington 391-H6 to North Woburn 375-H11 via RADSEC switches on P10/19 and P3/10 for a transfer of 3.3 MVA

Total Transfer: 22.4 MVA

Summary of Concerns:

1. Burlington Station #391 is overloaded --Inadequate transformer capacity under contingency conditions (2006)
2. 14 kV Distribution circuits 391-H3, 391-H7 and 391-H9 are overloaded under normal conditions (2004).

Without any significant major development projects during 2002-2008, the Burlington Supply region is projected to experience meager load growth; approximately 1.2% annual load growth. As a result of this small load growth based on load projections, starting in the summer of 2008 for a single-contingency outage of either transformer 110A or 110B, Burlington Station #391 will exceed the load carrying capability (1% over LTE, 1.6 MVA load risk).

Distribution Systems
DSS Lines
Burlington Station #391 has one line group the Raytheon-Burlington Line group. In addition Burlington Station #391 has one of the two DSS lines of the Sun Microsystems Line Group.

The **Raytheon-Burlington Line Group** consists of DSS lines 377-1395H and 307-1396H. The line group supplies customer Stations #346 and loped customer station #377. Both lines have distribution circuits tapped off the lines. Upon the loss of either DSS lines, the remaining DSS line will exceed not the long-term emergency capacity (LTE), based on 2004-2008 load projections.

The **Sun Microsystems Line Group** consists of two DSS lines 487-1367H and 487-1387H. The line group is a loop supply between Burlington Station #391 and Hartwell Avenue Station #533. Line 487-1387H originates at Burlington Station #391 and Line 487-1367 originates at Hartwell Avenue

Sta #533. The line group supplies customer Station #487. Both lines have distribution circuits tapped off the lines. Upon the loss of any of the DSS lines, the remaining DSS lines will not exceed the long-term emergency capacity (LTE), based on 2002 peak loads. The line 487-1376H has been relieved to 345-1379H1.

The following table provides the details on these line groups.

DSS Line	% of Normal 2004	LTE - % Load at Risk 2004	MVA at Risk 2004	LTE - % Load at Risk 2008	MVA at Risk 2008
377-1395H	67%	0%	0	0%	0
377-1396H	66%	0%	0	0%	0
487-1387H	25%	0%	0	0%	0

Loading on Burlington #391 DSS lines

Distribution Circuits

The twelve distribution circuits fed from Burlington #391 will have adequate capacity. In 2004 three circuits 391-H3, 391-H7 and 391-H9 are projected to exceed normal capacity with all lines in service. This heavy loading condition will be address by load transfers to adjacent Burlington distribution circuits and the installation of one or two new Station #391 distribution circuits. The following table shows the available capacity on the distribution circuits, respectively.

14 kV Radial Line	% of Normal 2002	Projected % of Normal 2004	Projected % of Normal 2008
391-H1	44%	54%	57%
391-H2	52%	72%	75%
391-H3	92%	**108%**	**112%**
391-H4	50%	59%	62%
391-H5	74%	87%	92%
391-H6	77%	91%	95%
391-H7	90%	**106%**	**111%**
391-H8	43%	51%	53%
391-H9	92%	**109%**	**114%**
391-H10	76%	90%	94%
391-H11	66%	78%	82%
391-H12	61%	72%	75%
391-H13	64%	75%	79%
391-H14	31%	36%	38%
391-H15	54%%	64%	67%

Loading on Burlington #391 14 kV distribution circuits

Burlington Station #391 does not supply any 4 kV stations.

Proposed Integrated Plan

The suggested actions in the table will address the concerns within the Burlington supply region. The primary focus of the plan is to expand Burlington Sta #391 by installing additional pumps and fans on transformers 110A and 110B. Burlington Station #391 with 120 MVA of firm capacity has ample transformer capacity to be the foundation of an integrated plan to support the Burlington supply region load beyond 2008. An alternative approach would be to transfer load to adjacent stations. Add two new feeder positions at Burlington Station #391 and install two new distribution circuits to relieve the overloaded distribution circuits.

Action	Year	Cost

	needed	
⇒ Install two 14kV distribution circuits to relieve distribution circuit overloads.	2004	$1.2 M
⇒ Burlington Station #391 add pumps & fans for both Transformers 110A and 110B or increase transfer switching	2008	$TBD

STATION 391

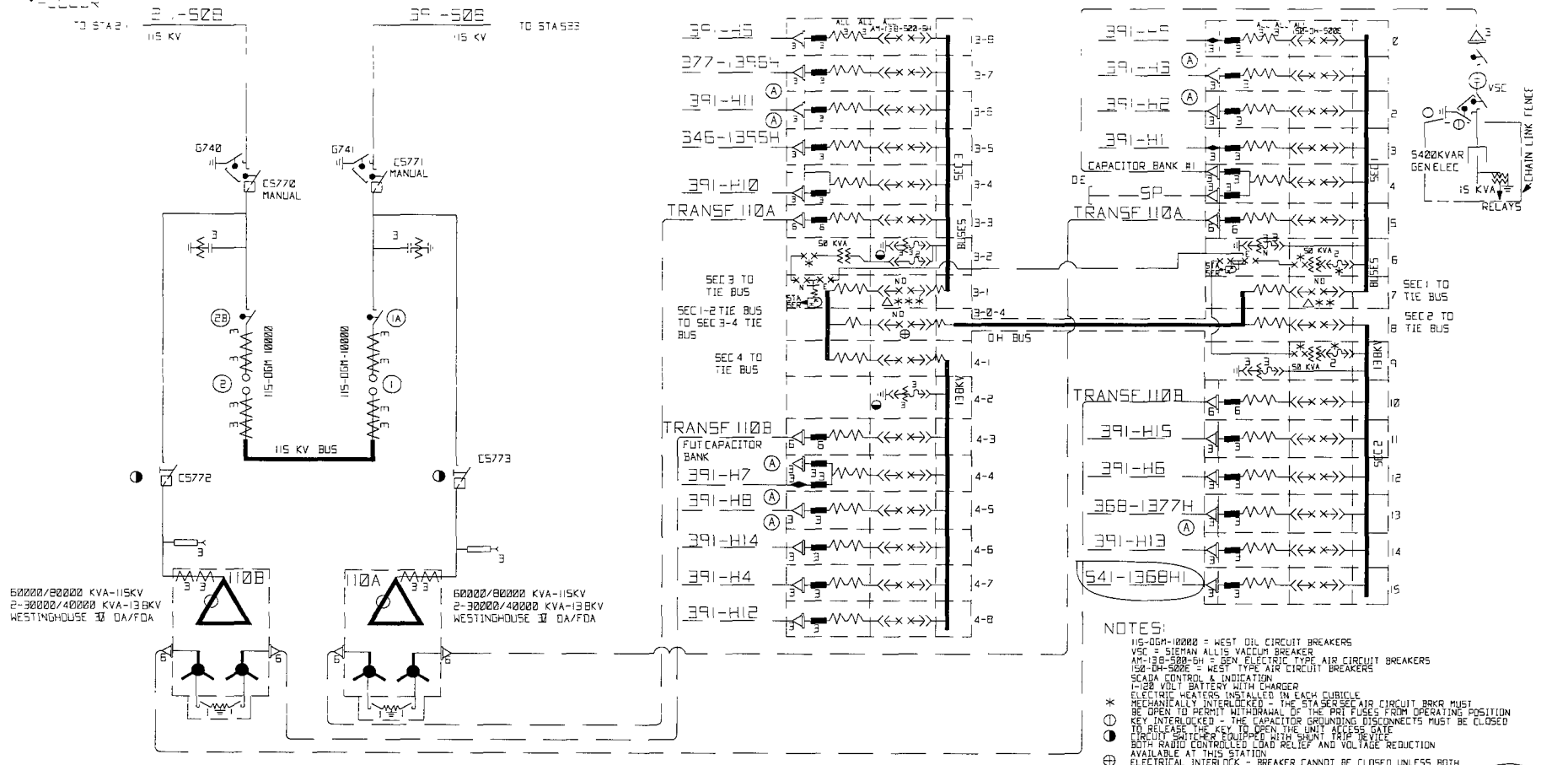
70 MIDDLESEX ST NEAR WHEELER ST BURLINGTON

COLOR KEY	
COLOR	DESCRIPTION
	DISTRIBUTION/RETAIL
	POWER SUPPLY TRANSMISSION

NOTES:

** NORMALLY OPEN - CLOSES AUTO ON LOSS OF BUS POTENTIAL AND TRANSFORMER LOAD ON SECTION #1 OR #2

*** NORMALLY OPEN - CLOSES AUTO ON LOSS OF BUS POTENTIAL AND TRANSFORMER LOAD ON SECTION #3 OR #4



NOTES:

115-DGM-10000 = WEST OIL CIRCUIT BREAKERS
VSC = SIEMAN ALLIS VACCUM BREAKER
AM-13B-500-SH = GEN. ELECTRIC TYPE AIR CIRCUIT BREAKERS
150-DH-5006 = WEST TYPE AIR CIRCUIT BREAKERS
SCADA CONTROL & INDICATION
1-120 VOLT BATTERY WITH CHARGER
ELECTRIC HEATERS INSTALLED IN EACH CUBICLE
* MECHANICALLY INTERLOCKED - THE STA SER SEC AIR CIRCUIT BRKR MUST BE OPEN TO PERMIT WITHDRAWAL OF THE PRI FUSES FROM OPERATING POSITION
⊖ KEY INTERLOCKED - THE CAPACITOR GROUNDING DISCONNECTS MUST BE CLOSED TO RELEASE THE KEY TO OPEN THE UNIT ACCESS GATE
◑ CIRCUIT SWITCHER EQUIPPED WITH SHUNT TRIP DEVICE
BOTH RADIO CONTROLLED LOAD RELIEF AND VOLTAGE REDUCTION AVAILABLE AT THIS STATION
⊕ ELECTRICAL INTERLOCK - BREAKER CANNOT BE CLOSED UNLESS BOTH BREAKERS OF 1 TRANSFORMER ARE OPEN
◒ NON-STANDARD BUS POTENTIAL TRANSFORMERS RATIO 12:1
△ BREAKER CANNOT BE CLOSED UNTIL AUTO-TIE SCHEME IS SET TO MANUAL

BOSTON EDISON COMPANY

DELIVERY ENGINEERING DEPARTMENT

ELECTRICAL DESIGN DRAFTING GROUP

DRAWN BY VCS

CHECKED BY

DATE JUNE 24,1996

391

2003 T&D OPERATING STUDY
WALTHAM DISTRICT

STATION #450 TRAPELO Road

Trapelo Road Station #450 supplies portions the towns of Waltham, Weston and Wayland. During the summer of 2002, Trapelo Road peak load was 81 MVA.

Trapelo Road Station #450 consists of two 115/13.8 kV transformers:
Transformer #110A: North American 37.5/50/62.5 MVA 117/14.4 kV
Transformer #110B: North American 37.5/50/62.5 MVA 117/14.4 kV

Trapelo Road Station #450 total capacity is 125 MVA. NSTAR employs summer emergency rating (cyclic capability) of 69 MVA for each of these two banks. Station #450's firm capacity is 69 MVA. Trapelo Road Station #450 has approximately 21 MVA of RADSEC transfer switching to adjacent stations Waltham #282, and Lexington Station #320. Trapelo Road's load carrying capability is 90 MVA.

Overload Ratings:

Transformer	Nameplate	12 hour LTE, 90F Ambient	12 hour LTE, 110F Ambient
110A	37.5/50/62.5 MVA	81 MVA	74 MVA
110B	37.5/50/62.5 MVA	81 MVA	74 MVA

Station Capabilities:

Total Station Capacity (N)	Station Firm Capacity (LTE)	RADSEC Transfer	Manual Transfer	Total LCC
125 MVA	69 MVA	21 MVA	0 MVA	90 MVA

2004-2008 Projected load:

2004	2005	2006	2007	2008
84 MVA	85 MVA	85 MVA	87 MVA	88 MVA

Switching Actions:

Loss of Transformer #110A:

Open: Circuit Switcher #CS771
Main 110A 13.8kV Circuit Breaker
Close: ABR scheme closes 13.8kV Bus Ties Automatically

Loss of Transformer #110B:

Open: Circuit Switcher #CS770
Main 110B 13.8kV Circuit Breaker
Close: ABR scheme closes 13.8kV Bus Ties Automatically

For loss of any transformer, transfer of the following DSS lines via RADSEC switches may also be required:

Trapelo Rd. 450-H5 to Lexington 320-H2 via RADSEC switches on P90/36A and P90/50 for a transfer of 4.0 MVA
Trapelo Rd. 450-H6 to Waltham 33-H2 via RADSEC switches on P 334/36 and P334/72 for a transfer of 3.0 MVA
Trapelo Rd. 450-H8 to Waltham 282-H5 via RADSEC switches on P 557/33 and P557/21 for a transfer of 3.9 MVA
Trapelo Rd. 450-H7 to Waltham 282-H1 via RADSEC switches on P8/38 and P21/78 for a transfer of 2.7 MVA
Trapelo Rd. 450-H2 to Waltham 282-H2 via RADSEC switches on P538/6 and P301/47 for a transfer of 3.5 MVA
Trapelo Rd. 450-H3 to Lexington 320-H3 via RADSEC switch on P15/5 for a transfer of 3.9 MVA.

Total Transfer: 21.0 MVA

Summary of Concerns:

1. Load on Trapelo Road #450 is expected to exceed the LCC (2008)
2. 450-H4 and 450-H7 will be nearing full capacity (2008)

Without any significant major development projects planned during the 2004-2008, the Trapelo Road Supply region is projected to experience meager load growth; approximately 1.1%. Based on the load projections, by the summer of 2008 for a single contingency outage of either transformer 110A or 110B, Trapelo Road Station #450 has adequate capacity to meet the load requirements and would be loaded to 98% of the load carrying capability.

Distribution Systems
DSS Lines
Trapelo Road Station #450 supplies the North Waltham line group.

The North Waltham Line Group consists of DSS lines 234-1358H, 463-1359 and 463-1360. The line group supplies customer stations 112, 145, 234, 373, 463, 526 and PMH 13751 and PMH13684. Line 234-1358H has a distribution circuit tapped off the line. Upon the loss of any DSS lines, the remaining DSS lines will not exceed the long-term emergency capacity (LTE), based on 2004-2008 peak load projections.

The following table provides details on the North Waltham Line Group.

DSS Line	% of Normal 2004	LTE - % Load at Risk 2004	MVA at Risk 2004	LTE - % Load at Risk 2008	MVA at Risk 2008
234-1358H	65%	0%	0	0%	0
463-1359	45%	0%	0	0%	0
463-1360	65%	0%	0	0%	0

Loading on Trapelo Road #450 DSS lines

14 kV Distribution Circuits

There are eight 14kV distribution circuits supplied by Trapelo Road Station #450. The distribution circuits 450-H2 and 450-H7 are expected to be heavily loaded by 2008, between 95%-100% of Normal Rating. Loading on the 14 kV distribution circuits are shown in the table below:

14 kV Circuit	% of Normal 2002	Projected % of Normal 2004	Projected % of Normal 2008
450-H1	76%	79%	83%
450-H2	**90%**	**93%**	**98%**
450-H3	45%	46%	49%
450-H4	71%	74%	78%
450-H5	33%	34%	35%
450-H6	77%	81%	86%
450-H7	88%	**92%**	**96%**
450-H8	41%	43%	45%

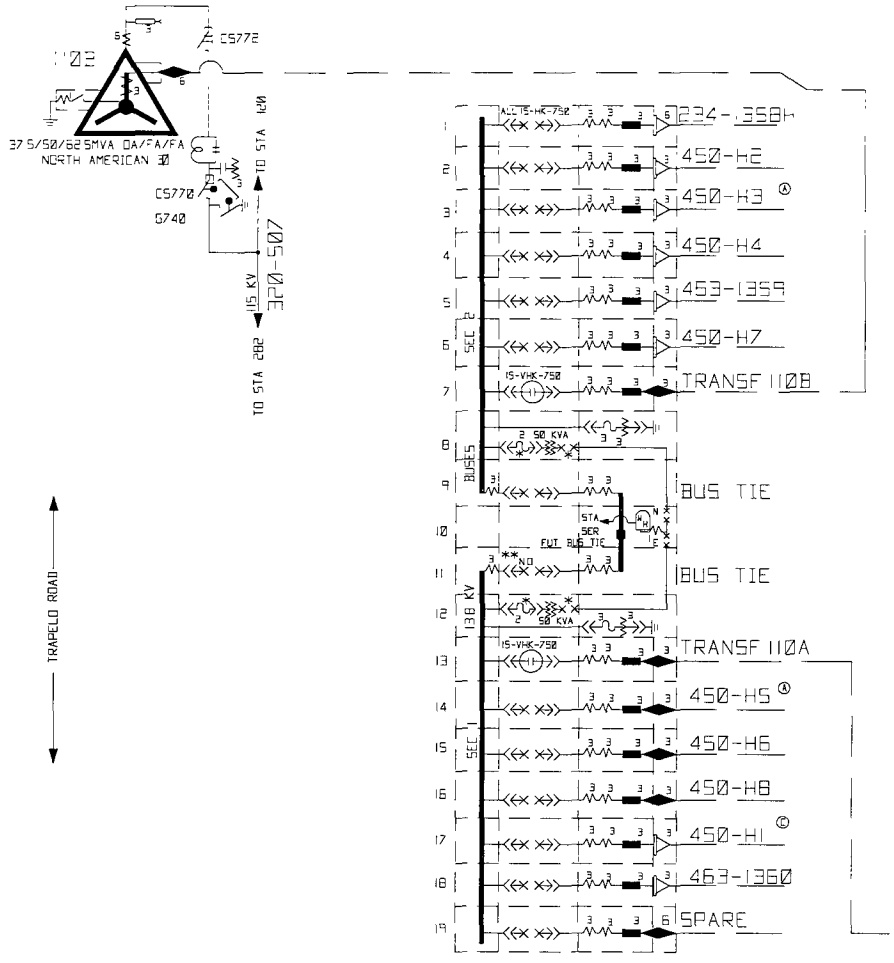
Loading on Trapelo Road #450 14 kV distribution circuits

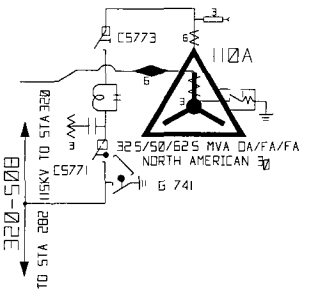
Trapelo Road Station #450 does not supply any 4 kV stations.

Proposed Integrated Plan

The suggested action in the table will address the concerns within the Trapelo Road supply region. Trapelo Road Sta #450 has adequate transformer capacity to support the projected meager load growth through 2008. A new circuit from Trapelo Road 450-H9 will be installed prior to the 2004 summer. This distribution circuit will relieve the Waltham Line Group and 14 kV distribution circuits 33-H2 and 320-H5. The heavily loaded 14kV distribution circuits will be relieve to the available capacity on adjacent distribution circuits.

Action	Year needed	Cost
⇒ Construct 450-H9 relieves 14 kV distribution circuits 320-H5 and the Waltham Line Group and 33-H2.	2004	$700K
⇒ Relieve 14kVdistribution circuits by transfer switching to adjacent circuits	2004-2008	None





STATION 450
1235 TRAPELO ROAD
AT SMITH STREET
WALTHAM

TEL #(617)424-2824

AUTO LOAD DISCONNECTION

ON LOSS OF EITHER TRANSFORMER & IF LOAD EXCEEDS 1900 AMPS, 450-H7 WILL TRIP IN 30 MINUTES, 450-H5 WILL TRIP 15 MINUTES LATER, & 450-H2 WILL TRIP IN AN ADDITIONAL 15 MINUTES

NOTES

15-HK-750=ITE TYPE AIR CIRCUIT BREAKERS

* KEY INTERLOCKED-THE AIR CIR BRKR ON THE SEC SIDE OF THE STA SER TRANSF MUST BE OPEN TO RELEASE THE KEY TO WITHDRAW THE PRI FUSES FROM OPERATING POSITION

1-130 VOLT CONTROL BATTERY WITH CHARGER

1-48 VOLT SUPERVISORY CONTROL BATTERY WITH CHARGER

SUPERVISORY CONTROL AND TELEMETERING VIA SCADA

BOTH RADIO CONTROLLED LOAD RELIEF AND VOLTAGE REDUCTION AVAILABLE AT THIS STATION

** NORMALLY OPEN-CLOSES AUTOMATICALLY ON LOSS OF POTENTIAL & LOAD ON EITHER BUS SECTION #1 OR #2 BY RELAY OPERATION ONLY

15-VHK-750 = ABB TYPE VACUUM CIRCUIT BREAKERS

CS772 DOES NOT HAVE A VISIBLE DISCONNECT SWITCH

DATE	DESCRIPTION	BY	CHCK
12/18/00	UPDATED DRAWING	WJB	DEF
7/3/01	UPDATED DRAWING	EBA	

NSTAR ELECTRIC
AN NSTAR COMPANY

450

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2003 T&D OPERATING STUDY
WALTHAM DISTRICT

STATION #467 WATERTOWN

Watertown Station #467 supplies the town of Watertown and portions of the communities of Newton, Waltham and Brighton. During the summer of 2002, Watertown peak load was 127 MVA.

Watertown Avenue Station #467 consists of two 115/13.8 kV transformers:
Transformer #110A: Westinghouse 75/100/125 [140] MVA 115/13.8/13.8 kV
Transformer #110B: Westinghouse 75/100/125 [140] MVA 115/13.8/13.8 kV

Watertown Station #467 total capacity is 250 MVA. NSTAR employs summer emergency rating (cyclic capability) of 144 MVA for each of these two banks. Station #467's firm capacity is 144 MVA. Watertown Station #467 does not have transfer to adjacent station. Watertown's load carrying capability is 144 MVA.

Overload Ratings:

Transformer	Nameplate	12 hour LTE, 90F Ambient	12 hour LTE, 110F Ambient
110A	75/100/125 [140] MVA	167 MVA	156 MVA
110B	75/100/125 [140] MVA	167 MVA	156 MVA

Station Capabilities:

Total Station Capacity (N)	Station Firm Capacity (LTE)	RADSEC Transfer	Manual Transfer	Total LCC
250 MVA	144 MVA	0 MVA	0 MVA	144 MVA

2004-2008 Projected load:

2004	2005	2006	2007	2008
138 MVA	138 MVA	139 MVA	141 MVA	143 MVA

Switching Actions:

Loss of Transformer #110A:

Open: Circuit Switcher #CS771
Both Main 110A 13.8kV Circuit Breakers
Close: ABR scheme closes 13.8kV Bus Ties Automatically

Loss of Transformer #110B:

Open: Circuit Switcher #CS771

Both Main 110B 13.8kV Circuit Breakers
Close: ABR scheme closes 13.8kV Bus Ties Automatically

No 13.8kV Distribution Transfers at this station.

Summary of Concerns:

1. Circuits 467-H3 and 467-H10 will be at or near full capacity in 2004
2. Circuits 467-H5 and 467-H12 will be heavily loaded (2008)

Without any significant major development projects planned during the 2004-2008, the Watertown Supply region is projected to experience meager load growth; approximately 1.0%. Based on the load projections, by the summer of 2008 for a single contingency outage of either transformer 110A or 110B, Watertown Station #467 has adequate capacity to meet the load requirements and would be loaded to 99% of the load carrying capability.

Distribution Systems

DSS Lines

Watertown Station #467 has four line groups; the East Watertown, Gateway, Raytheon Watertown and Spring Street line groups.

The East Watertown Line Group consists of DSS lines 370-1323 and 370-1327. The line group supplies customer Stations #370, 305 and 410. Upon the loss of either DSS lines, the remaining DSS line will not exceed the long-term emergency capacity (LTE), based on 2004-2008 peak load projections.

The Gateway Line Group consists of three DSS lines 277-1365H, 277-1367H and 277-1368. The line group supplies NSTAR Station #277 Washington Street, Newton. Both lines 277-1365H and 277-1367H have distribution circuits tapped off the lines. Upon the loss of any of the DSS lines, the remaining DSS lines will not exceed the long-term emergency capacity (LTE), based on 2004-2008 peak load projections.

The Raytheon Watertown Line Group consists of DSS lines 231-1351 and 231-1355. The line group supplies customer Stations #231, 194-1 and 194-2. Upon the loss of either DSS lines, the remaining DSS line will not exceed the long-term emergency capacity (LTE), based on 2004-2008 peak load projections.

The Spring Street Line Group consists of three DSS lines 124-1324, 124-1326 and 124-1328. The line group supplies customer NSTAR Station #124, Watertown. Upon the loss of any of the DSS lines, the remaining DSS lines will not exceed the long-term emergency capacity (LTE), based on 2004-2008 peak load projections.

The following table provides details on the Watertown Station #467 line groups.

DSS Line	% of Normal 2004	LTE - % Load at Risk 2004	MVA at Risk 2004	LTE - % Load at Risk 2008	MVA at Risk 2008
370-1323	10%	0%	0	0%	0
370-1327	55%	0%	0	0%	0
277-1365H	45%	0%	0	0%	0
277-1367H	46%	0%	0	0%	0
277-1368	90%	0%	0	0%	0
231-1351	15%	0%	0	0%	0
231-1355	25%	0%	0	0%	0
124-1324	30%	0%	0	0%	0
124-1326	70%	0%	0	0%	0
124-1328	40%	0%	0	0%	0

Loading on Watertown #467 DSS lines

14 kV Distribution Circuits

There are fourteen 14 kV distribution circuits supplied by Watertown Station #467. Distribution circuits 467-H3 and 467-H10 are expected to exceed their normal capacity in the 2004-2006 time frame, and circuits 467-H5 and 467-H12 will be heavily loaded by 2008. There is a new circuit currently under construction, 467-H14. Loading on the 14 kV distribution circuits are shown in the table below:

14 kV Circuit	% of Normal 2002	Projected % of Normal 2004	Projected % of Normal 2008
467-H1	77%	84%	87%
467-H2	63%	69%	71%
467-H3	91%	99%	**102%**
467-H4	77%	84%	87%
467-H5	87%	94%	98%
467-H6	71%	78%	80%
467-H7	61%	67%	69%
467-H8	80%	87%	90%
467-H9	60%	65%	68%
467-H10	92%	**100%**	**103%**
467-H11	72%	84%	87%
467-H12	87%	95%	98%
467-H13	72%	78%	81%
467-H14	N/A	66%	66%

Loading on Watertown #467 14 kV distribution circuits

4kV Station

Watertown #467 supplies two 4kV stations: Spring Street #124 and Washington Street, Newton Station #277. Both Station #124 and #277 are three 14/4 kV transformer stations. Upon the loss of one of the three 14/4 kV transformers, the remaining transformers will not exceed its long-term emergency capacity. There is no load at risk for this event at either 4kV station.

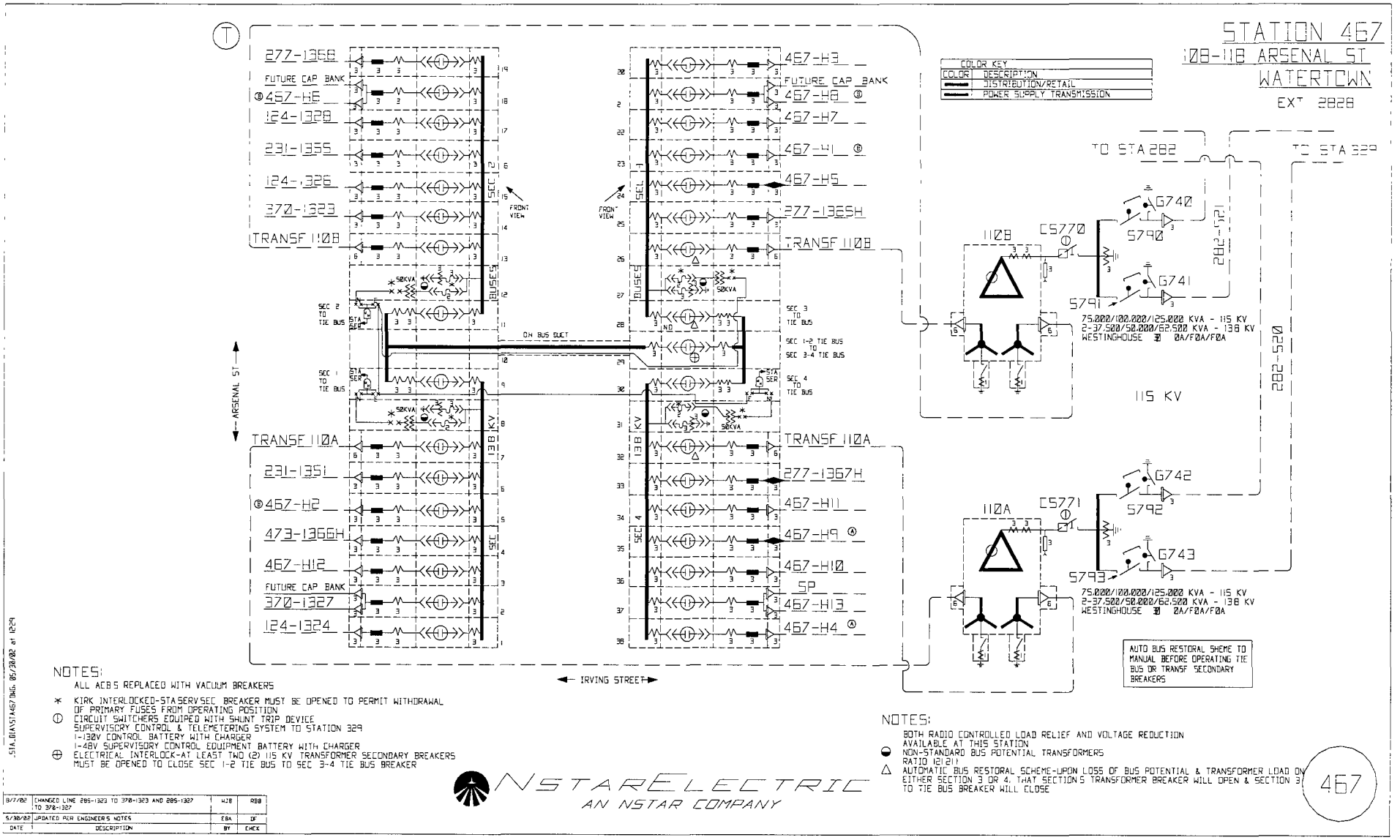
4 kV Station	2002 Peak (MVA)	LTE Capacity (MVA)	2004 Projection (MVA)	2008 Projection (MVA)
Spring St #124	7.6	8.4	7.7	8.0
Washington St #277	8.0	12.0	8.2	8.5

***Loading on 4 kV stations fed from* Watertown #467**

Proposed Integrated Plan

The suggested action in the table will address the concerns within the Watertown supply region. Watertown Sta #467 has adequate transformer capacity to support the projected meager load growth through 2008. A new circuit 467-H14 will be installed prior to the 2004 summer. The heavily loaded 14 kV distribution circuits will be relieve to the available capacity on adjacent distribution circuits.

Action	Year needed	Cost
⇒ Complete the construction of 467-H14 and relieve 14 kV distribution circuits by transfer switching to adjacent circuits	2004-2008	None



NOTES:

ALL ACB'S REPLACED WITH VACUUM BREAKERS

* KIRK INTERLOCKED-STA SERV SEC. BREAKER MUST BE OPENED TO PERMIT WITHDRAWAL OF PRIMARY FUSES FROM OPERATING POSITION

Ⓣ CIRCUIT SWITCHERS EQUIPED WITH SHUNT TRIP DEVICE
SUPERVISORY CONTROL & TELEMETERING SYSTEM TO STATION 329
1-130V CONTROL BATTERY WITH CHARGER
1-48V SUPERVISORY CONTROL EQUIPMENT BATTERY WITH CHARGER

⊕ ELECTRICAL INTERLOCK-AT LEAST TWO (2) 115 KV TRANSFORMER SECONDARY BREAKERS MUST BE OPENED TO CLOSE SEC 1-2 TIE BUS TO SEC 3-4 TIE BUS BREAKER

NOTES:

BOTH RADIO CONTROLLED LOAD RELIEF AND VOLTAGE REDUCTION AVAILABLE AT THIS STATION

◒ NON-STANDARD BUS POTENTIAL TRANSFORMERS RATIO (2|2|1)

△ AUTOMATIC BUS RESTORAL SCHEME-UPON LOSS OF BUS POTENTIAL & TRANSFORMER LOAD ON EITHER SECTION 3 OR 4, THAT SECTION'S TRANSFORMER BREAKER WILL OPEN & SECTION 3 TO TIE BUS BREAKER WILL CLOSE

DATE	DESCRIPTION	BY	CHECK
8/7/02	CHANGED LINE 285-1323 TO 370-1323 AND 285-1327 TO 370-1327	WJB	RBB
5/30/02	UPDATED PER ENGINEER'S NOTES	EBA	DF

NSTAR ELECTRIC
AN NSTAR COMPANY

467

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2003 T&D OPERATING STUDY
WALTHAM DISTRICT

STATION #533 HARTWELL AVE. (NO. LEXINGTON)

Hartwell Avenue, Station #533 supplies the towns of Bedford, Carlisle, the northern and western portions of the town of Lexington and the western portion of the town of Burlington. During the summer of 2002, Hartwell Avenue peak load was 91 MVA.

Hartwell Avenue Station #533 consists of two 115/13.8 kV transformers:

Transformer #110A: McGraw-Edison 75/100/125 [140] MVA 115/14.4/14.4 kV
Transformer #110B: McGraw-Edison 75/100/125 [140] MVA 115/14.4/14.4 kV

Hartwell Station #533 total capacity is 250 MVA. NSTAR employs summer emergency rating (cyclic capability) of 151 MVA for each of these two banks. Station #533's firm capacity is 151 MVA. Hartwell Avenue Station #533 has approximately 8 MVA of transfer switching to adjacent station Lexington Sta #320. Hartwell Avenue's load carrying capability is 158 MVA.

Overload Ratings:

Transformer	Nameplate	12 hour LTE, 90F Ambient	12 hour LTE, 110F Ambient
110A	75/100/125 [140] MVA	180 MVA	168 MVA
110B	75/100/125 [140] MVA	180 MVA	168 MVA

Station Capabilities:

Total Station Capacity (N)	Station Firm Capacity (LTE)	RADSEC Transfer	Manual Transfer	Total LCC
250 MVA	151 MVA	8 MVA	0 MVA	159 MVA

2004-2008 Projected load:

2004	2005	2006	2007	2008
93 MVA	93 MVA	94 MVA	95 MVA	97 MVA

Switching Actions:

Loss of Transformer #110A:

Open: Circuit Switcher #CS771
Both Main 110A 13.8kV Circuit Breakers
Close: ABR scheme closes 13.8kV Bus Ties Automatically

Loss of Transformer #110B:

Open: Circuit Switcher #CS770

Both Main 110B 13.8kV Circuit Breakers
Close: ABR scheme closes 13.8kV Bus Ties Automatically

Summary of Concerns:

1. Bedford Line Group DSS line 533-H5 is overloaded under contingency conditions (2004)
2. Raytheon Bedford Line Group DSS lines 512-1399H overload under contingency conditions (2004)
3. Sun Microsystems Line Group DSS lines 487-1376H overload under contingency conditions (2004)
4. Heavy Loading conditions on several 14 kV distribution circuits (2008)

Without any significant major development projects planned during the 2004-2008, the Hartwell Avenue Supply region is projected to experience meager load growth; approximately 1.1%. Based on the load projections, by the summer of 2008 for a single contingency outage of either transformer 110A or 110B, Hartwell Avenue Station #533 has adequate capacity to meet the load requirements and would be loaded to 60% of the load carrying capability.

Distribution Systems

DSS Lines

Hartwell Avenue Station #533 has four line groups; the Bedford, Raytheon Bedford, Lincoln Labs and Sun Microsystems line groups.

The Bedford Line Group consists of DSS lines 322-1386, 322-1397H and 533-H5. The line group supplies NSTAR station #322 South Street, Bedford and customer Stations #559. Upon the loss of a DSS lines, the remaining DSS line will exceed the long-term emergency capacity (LTE), based on 2004-2008 peak load projections.

The Raytheon Bedford Line Group consists of DSS lines 512-1398H and 512-1399H. The line group supplies customer Stations #461 and 512. Both lines 512-1398H and 512-1399H have distribution circuits tapped off the lines. Upon the loss of DSS line 512-1399H, the DSS line 512-1398H will exceed the long-term emergency capacity (LTE), based on 2004-2008 peak load projections.

The Lincoln Labs Line Group consists of three DSS lines 115-1387, 115-1388 and 115-1389. The line group supplies customer station #115. Upon the loss of any of the DSS lines, the remaining DSS lines will not exceed the long-term emergency capacity (LTE), based on 2004-2008 peak load projections.

The Sun Microsystems Line Group consists of two DSS lines, 487-1376H and 487-1387H. The line group is a loop supply between Hartwell Avenue, Station #533 and Burlington Station #391. The line group supplies customer Station #487Veterans Hospital, Bedford. Both 487-1376H and 487-1387H have distribution circuits tapped off the lines. Upon the loss of either DSS lines, the remaining DSS lines will exceed the long-term emergency capacity (LTE), based on 2002 peak loads.

The following table provides details on the Hartwell Avenue Station #533 line groups.

DSS Line	% of Normal 2004	LTE - % Load at Risk 2004	MVA at Risk 2004	LTE - % Load at Risk 2008	MVA at Risk 2008
322-197H	78%	0%	0	0%	0
322-1386	34%	0%	0	0%	0
533-H5	86%	**8%**	**0.8**	**11%**	**1.1**
512-1398H	28%	0%	0	0%	0
512-1399H	98%	**10%**	**0.3**	**28%**	**0.8**
115-1387	66%	0%	0	0%	0
115-1388	42%	0%	0	0%	0
115-1389	66%	0%	0	0%	0
487-1376H	70%	**3%**	**0.4**	**5%**	**0.6**

Loading on Hartwell Ave #533 DSS lines

14 kV Distribution Circuits

The seven 14 kV distribution circuits fed from Hartwell Station #533. Considering the modest load growth the distribution circuits will have sufficient capability. By 2008 three circuits are projected to be 93%- 100% of its normal capacity with all lines in service. NSTAR will relieve these heavily loaded circuits to the adjacent circuits. The loading on the 14 kV distribution circuits is shown in the table below:

14 kV Circuit	% of Normal 2002	Projected % of Normal 2004	Projected % of Normal 2008
533-H1	51%	53%	55%
533-H2	70%	72%	76%
533-H3	100%	89%	93%
533-H4	83%	84%	88%
533-H5	93%	94%	98%
533-H7	62%	64%	66%
533-H8	0%	93%	93%

Loading on Hartwell Avenue #533 14 kV distribution circuits

4kV Station

Hartwell Avenue #533 supplies one 4kV station: Bedford Station #322 (South Street). Upon the loss of one of its two 5 MVA transformers, the remaining transformer will not exceed its long-term emergency capacity. There is no load at risk in this event.

4 kV Station	2002 Peak (MVA)	LTE Capacity (MVA)	2004 Projection (MVA)	2008 Projection (MVA)
Bedford #322	3.4	6.0	3.5	3.6

Loading on 4 kV station fed from Hartwell Avenue #533

Proposed Integrated Plan

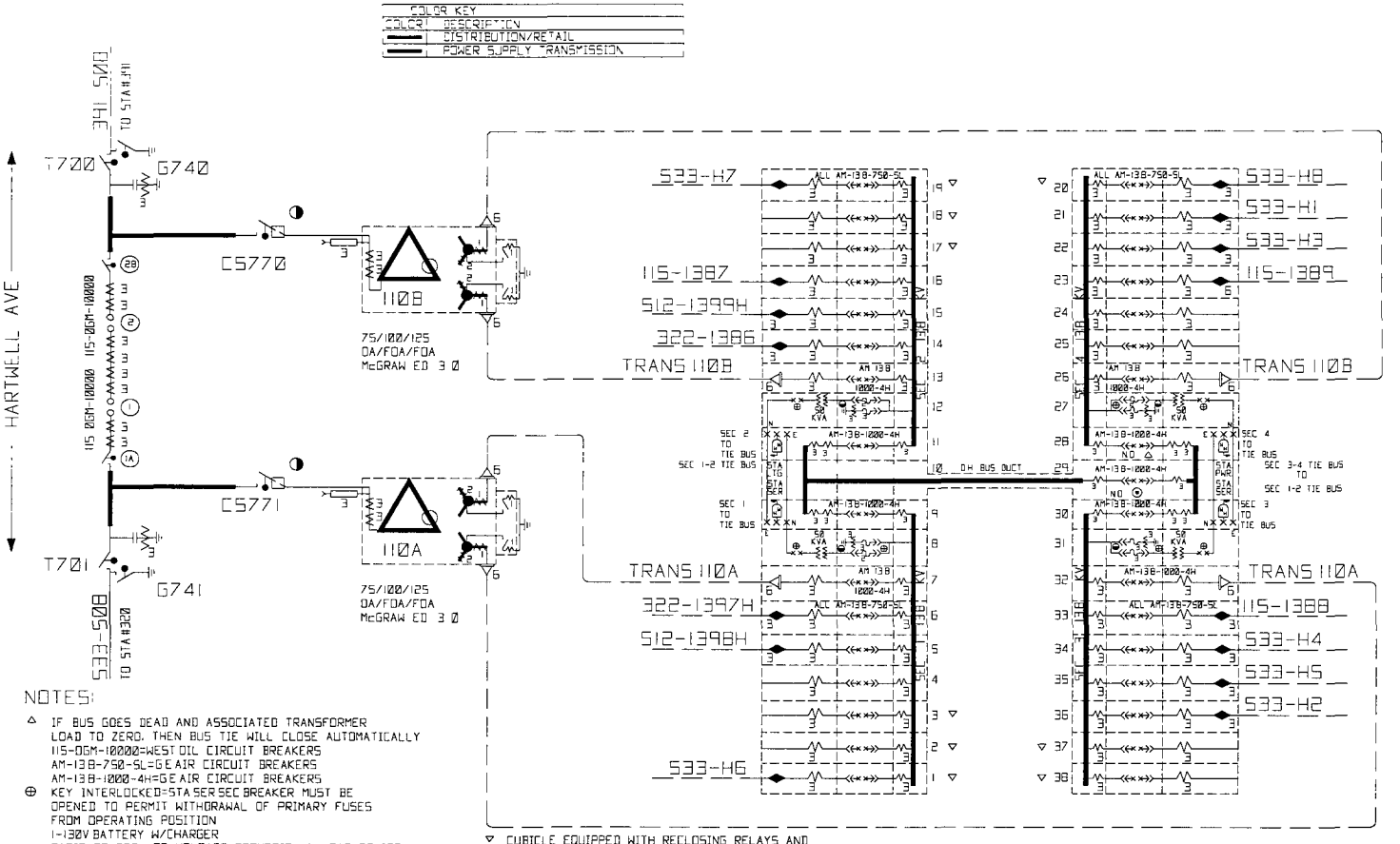
The suggested action in the table will address the concerns within the Hartwell Avenue supply region. Hartwell Avenue Sta #533 has adequate transformer capacity to support the projected meager load growth well beyond 2008. Hartwell Avenue #533 has nine spare feeder positions that can support the installation of new distribution circuits that would relieve the heavily loaded Bedford, Raytheon Bedford, and Sun Microsystems line groups and the 14 kV distribution circuits. An alternative approach would either reconductor the heavily lines or transfer load to lighter loaded adjacent circuits.

Action	**Year needed**	**Cost**
⇒ New 14kV distribution circuit 533-H8 to relieve 14 kV distribution load supplied by Raytheon Bedford and Bedford Line Groups	2003 -2004	$700K
⇒ Install a new distribution circuit at Hartwell Ave #533 to relieve heavy loading on several 14kV distribution circuits	2008	TBD

STATION 533

HARTWELL AVE
LEXINGTON

TEL-932-7149



NOTES:

△ IF BUS GOES DEAD AND ASSOCIATED TRANSFORMER LOAD TO ZERO, THEN BUS TIE WILL CLOSE AUTOMATICALLY
115-06M-10000=WEST OIL CIRCUIT BREAKERS
AM-13B-750-SL=GE AIR CIRCUIT BREAKERS
AM-13B-1000-4H=GE AIR CIRCUIT BREAKERS

⊕ KEY INTERLOCKED=STA SER SEC BREAKER MUST BE OPENED TO PERMIT WITHDRAWAL OF PRIMARY FUSES FROM OPERATING POSITION
1-130V BATTERY W/CHARGER
RADIO CONTROLLED VOLTAGE REDUCTION & LOAD RELIEF AVAILABLE AT THIS STATION

◑ CIRCUIT & SWITCHER EQUIPPED W/SHUNT TRIP DEVICE

◒ NON-STANDARD BUS POTENTIAL TRANSFORMERS,RATIO 121211 CURRIER SMITH ALARMING

▽ CUBICLE EQUIPPED WITH RECLOSING RELAYS AND LOAD SHEDDING EQUIPMENT

⊙ ELECTRICAL INTERLOCK-BREAKER CANNOT BE CLOSED UNLESS ANY TWO TRANSF BREAKERS ARE OPEN SCADA SUPERVISORY & CONTROL

BOSTON EDISON CO
EE & SOD DESIGN SERVICES

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DATE JULY 29,1996